All signs point to a continued "seller's market" in wire, this year of grace. Salesmen have become order-takers—and yet your ability to deliver as promised, with unblemished service and product-quality maintained, will be remembered to your advantage when "selling" becomes a full-time job again. In 1940 and after, the high speed and dependability of VAUGHN Wire Drawing Machinery, plus its unique flexibility for ready response to changing market conditions, will put VAUGHN users in a consistently enviable position. Right now it's your move —with a Vaughn Engineer waiting for your call!

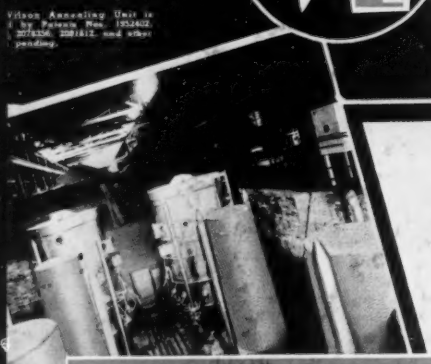
THE VAUGHN MACHINERY COMPANY ·· CUYAHOGA FALLS, OHIO

VAUGHN

WIRE DRAWING MACHINERY

COMPLETE WIRE DRAWING EQUIPMENT . . . CONTINUOUS OR SINGLE HOLE . . . FOR THE LARGEST BARS . . . FOR THE SMALLEST WIRE . . . FERROUS, NON-FERROUS MATERIALS OR THEIR ALLOYS

his is only **1/2** OF THE WIRE ANNEALING INSTALLATION *at* WICKWIRE BROTHERS *Company*

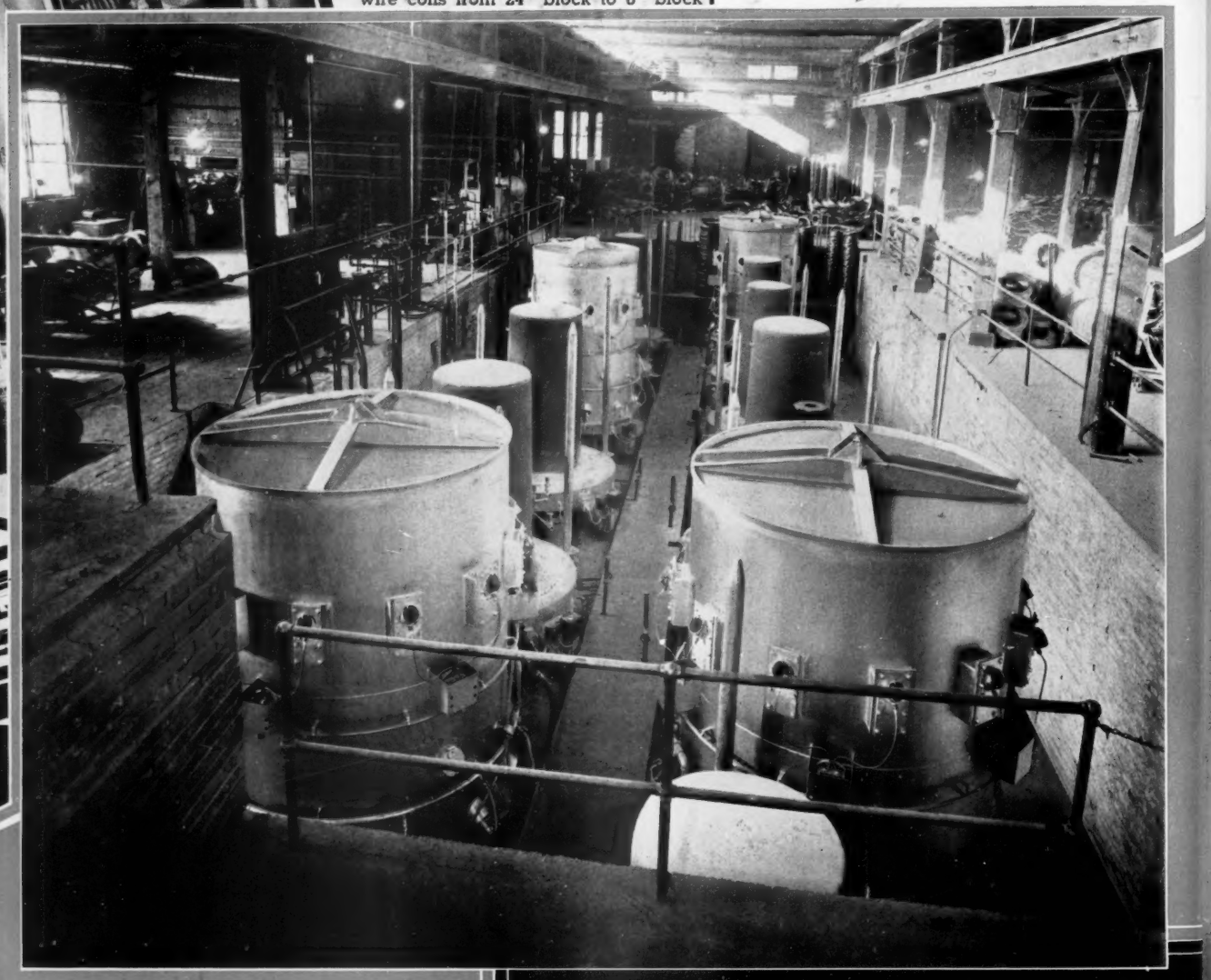


THESE two WILSON Wire Annealing Units had only been in service seven weeks at the Wickwire Bros. Co., Cortland, N. Y., when two additional units were ordered.

The successful bright treatment of wire coils from 24" block to 8" block

Here is the complete WILSON installation at WICKWIRE BROTHERS CO.

Each seven days these four Wilson Furnaces anneal 340 tons of low carbon wire in 24", 22", 16", 12" and 8" coils to dead softness and to a uniformity within extremely close limits, and scale free and bright.



Typical of Wilson's wire annealing installations, this unit is reducing costs, making more rapid turn-over of production, eliminating most cleaning, and justifying our claim of the Most of the Best Annealing for the Least Cost.

An Exclusive Development of

LEE WILSON ENGINEERING CO.

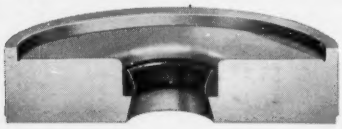
1370 Blount Street • Cleveland, Ohio

• The Wilson Annealing Unit is covered by Patents Numbers 1952402, 2068477, 2078356, 2081612, and other patents pending.

LW

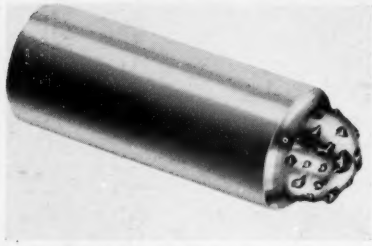
Sheet Metal Draw Dies

The ability of Carboloy cemented carbide dies to produce an unusually fine finish and to hold work within extremely close size limits for long periods of operation is of particular value for sheet metal drawing. This is especially true on high-speed, quantity-production eyelet machines where



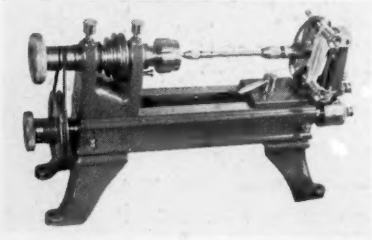
every minute of downtime means a production loss up to 300 pieces. Producers of eyelets for shoes, lamp bulb bases, lipstick tubes, charged water cartridges, pencil caps, radio tubes and many other products are finding Carboloy dies of unusual value. Die sizes now in use for drawing non-ferrous and ferrous stock range from the smallest eyelet die up to 6″ I. D.

Diamond-Impregnated Carboloy Dressers For Nail Die Emery Wheels



Mills making nails have found diamond-impregnated Carboloy dressers unusually economical for the dressing of emery wheels used in the manufacture of nail dies. Carboloy diamond dressers, as compared to single diamond dressers, eliminate all remounting expense, withstand accidental abuse and prevent costly diamond loss or waste. Containing a multitude of diamond particles impregnated in a special Carboloy matrix, Carboloy dressers have a cutting surface that is automatically renewed by making a ¼ turn of the dresser in its holder. Ask for catalog DR-38.

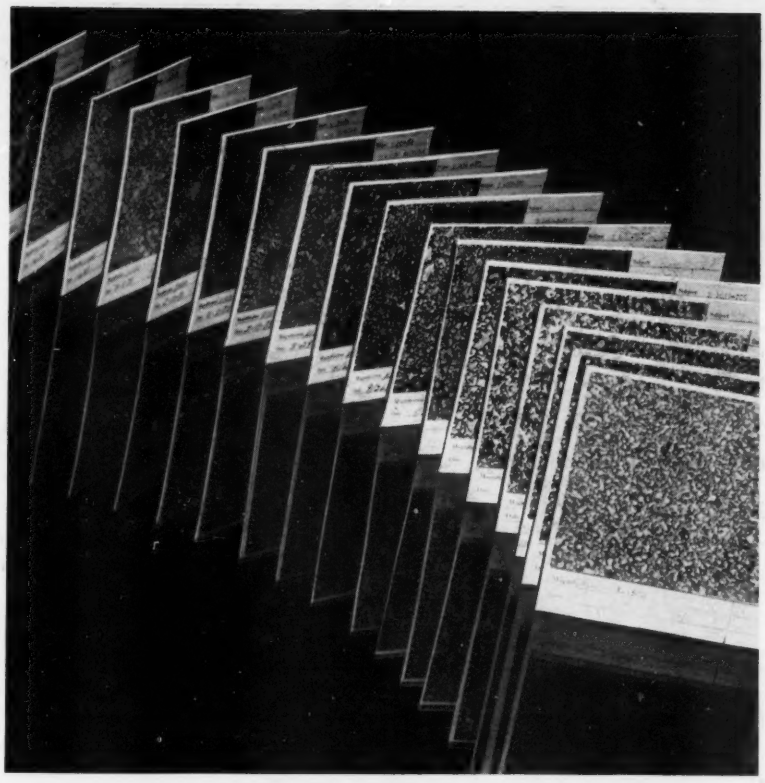
Semi-Automatic Polisher



Practically a universal machine for manufacturing and servicing Carboloy Dies from .010″ to .750″ hole size and up to a maximum 3″ casing. Can be used with collet or chuck. Designed for hand or automatic lapping, also (by adding a compound) for boring. For complete specifications and prices write for catalog D-103.

Carboloy Masonry Drills

Your maintenance man would like to know about the Carboloy Masonry Drill. Drills concrete, brick, tile, etc., 75% faster than old methods. Ask for leaflet GT-103.



388 Grades That Didn't Quite "*Make The Grade*"!

To make cemented carbide, you take powdered metals—such as tungsten, tantalum, or titanium—carburize them, add a metallic binder, ball mill, press and sinter.

Basically that is the procedure.

There are, however, countless possible variations at each step, any one of which may affect the characteristics, quality and performance of the cemented carbide produced.

In our effort to learn more about these variations and constantly improve cemented carbides, approximately 400 different types have been produced by Carboloy metallurgists. The "cream" of these are the 12 grades now regularly available.

The others . . . the 388 grades that didn't quite "make the grade" . . . are good carbides but not quite good enough to meet rigid standards of Carboloy quality and performance.

Thus, when you put Carboloy on the job, you back your judgment with the knowledge that the grade you use has been selected by experienced metallurgists as "tops" among several hundred grades.

CARBOLOY COMPANY, INC., 11171 E. 8 Mile Blvd., DETROIT, MICHIGAN

CHICAGO • CLEVELAND • NEWARK
PITTSBURGH • PHILADELPHIA
WORCESTER, MASS.

The Mark of CARBOLOY
REG. U.S. PAT. OFF.

Authorized Distributors:
Canadian Gen. Elec. Co., Ltd., Toronto
Hartley Wire Die Co., Waterbury, Conn.

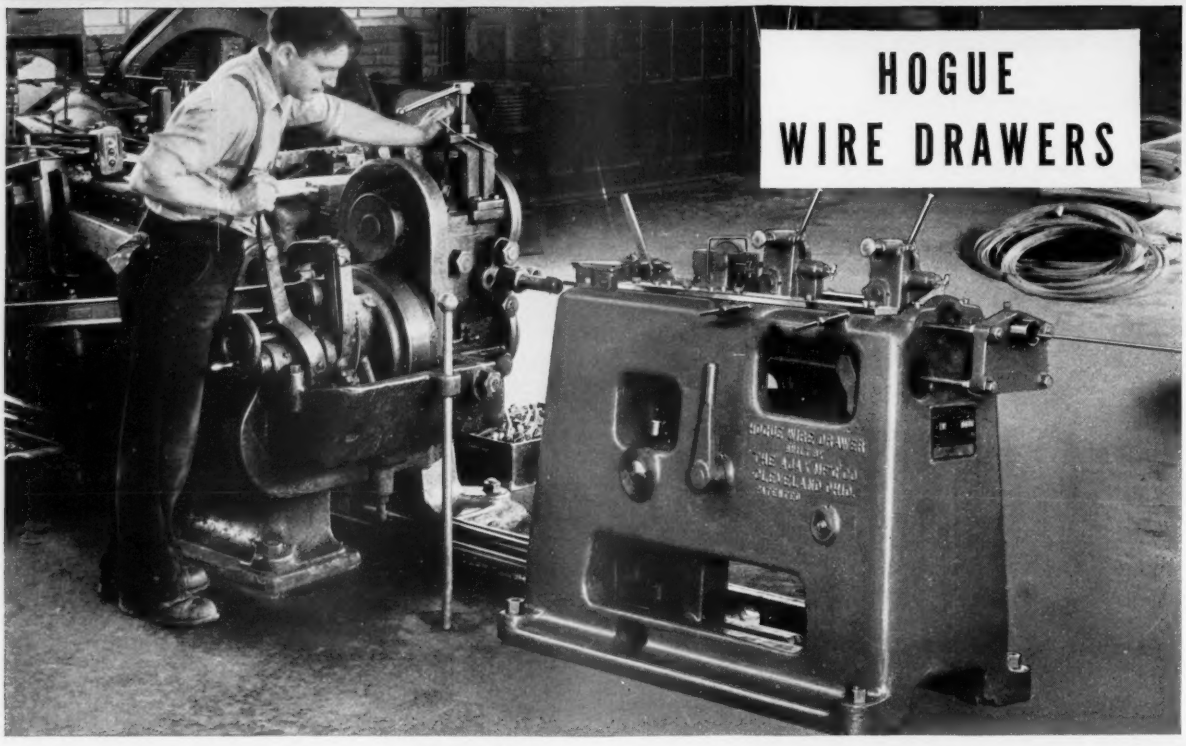
CARBOLOY

REG U S PAT OFF

TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE

FOR CUTTING, DRAWING, SHAPING, EXTRUDING METALS AND NON-METALLICS
★ FOR REDUCING WEAR ON EQUIPMENT OR PRODUCTS YOU USE OR MAKE ★

AJAX



REDUCE COLD HEADING DIE COSTS

Increase header die life — Substantially longer heading die life, especially for close specification products, and increased operating efficiency result from straight, accurate, clean and freshly-drawn wire free from age hardening and gritty accumulation.

Increase Profits—Because of savings in heading die costs and lower drawing costs, even in plants which already have their own cold drawing department, profits are substantially increased by the use of Ajax Hogue Wire Drawers.

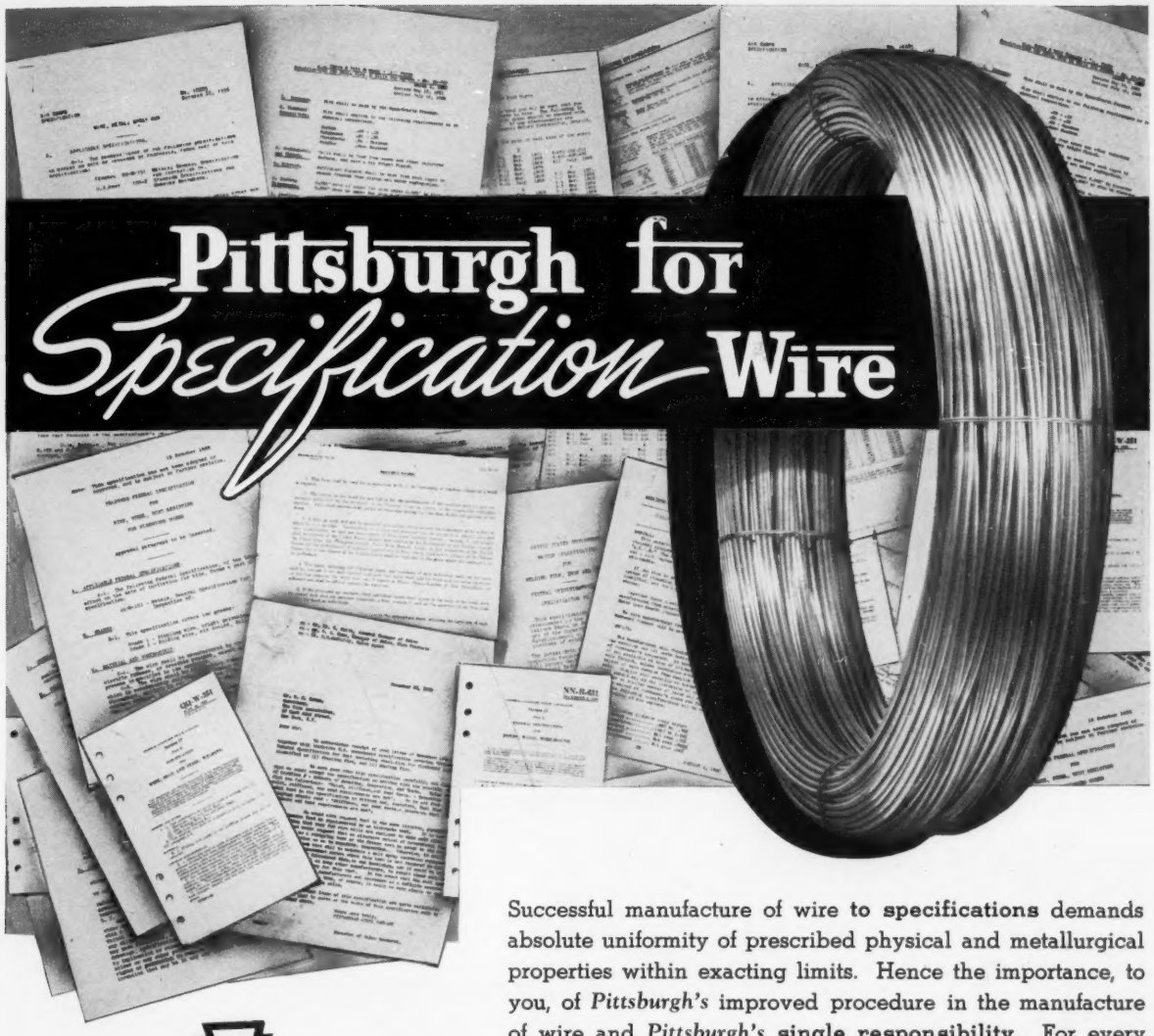
•

This repeat order for seven Ajax Hogue Wire Drawers, from a company already operating its own cold drawing department, was the result of the profits from a trial installation.

Write for Bulletin No. 111

THE AJAX MANUFACTURING COMPANY
EUCLID BRANCH P. O., CLEVELAND
621 MARQUETTE BUILDING
CHICAGO, ILL.
201 DEWART BUILDING
NEW LONDON, CONN.

Pittsburgh for *Specification* Wire



Successful manufacture of wire **to specifications** demands absolute uniformity of prescribed physical and metallurgical properties within exacting limits. Hence the importance, to you, of *Pittsburgh's* improved procedure in the manufacture of wire and *Pittsburgh's* **single responsibility**. For every coil and every shipment from ore to finished wire, is made in the same plant, by the same processes, with the same equipment, by the same craftsmen and under the supervision of the same organization of wire specialists. The results—unvarying **control** of steel, structure, temper, surface, gauge and cast. Add 38 years of wire manufacturing experience and you have good reasons for entrusting to *Pittsburgh*, with equal confidence, your most difficult assignment, or your ordinary, day-by-day wire needs.

Note elsewhere, this issue, the Mordica Memorial Lecture by Dr. Braley

PITTSBURGH STEEL COMPANY

1641 Grant Building - Pittsburgh, Pa.

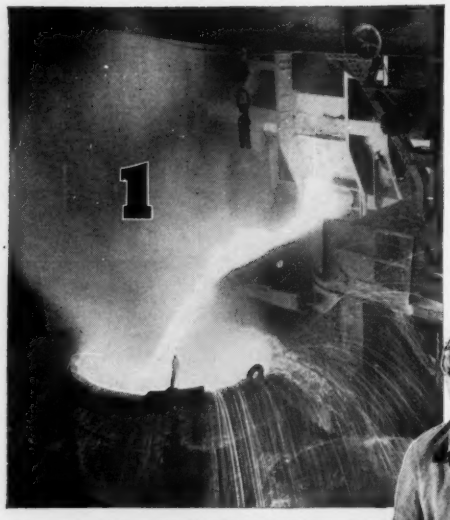
NEW YORK DETROIT CHICAGO CLEVELAND HOUSTON
TULSA LOS ANGELES

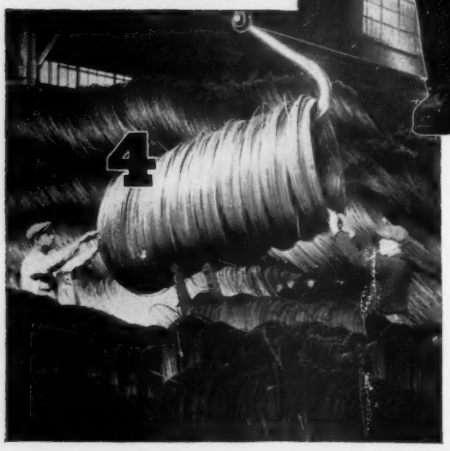
Pittsburgh Wires

A COMPLETE LINE FOR ALL FABRICATING NEEDS

RODS

TAILOR-MADE TO YOUR NEEDS





All Bethlehem asks is for you to name your job for rods. We have the capacity, the modern machinery and the metallurgical background to supply you with rods in:

1 THE GRADE OF STEEL YOU WANT—Our Maryland and Cambria plants furnish rods in basic or acid open-hearth or Bessemer steels in a wide range of analyses.

2 THE HEAT-TREATMENT YOU WANT—We furnish rods patented, annealed, normalized, or spheroidized—heat-treated to fully meet the requirements of virtually every type of job for which steel rods are used.

3 THE FINISH YOU WANT—In addition to the as-rolled condition, we furnish rods pickled, limed and baked; pickled and oiled . . . finishes to meet any manufacturing need.

4 THE TONNAGE YOU WANT—Bethlehem's modern rod mills have the capacity required to fill orders of any size promptly and economically.

A Bethlehem wire-rod specialist will be glad to make his recommendations on the material best suited to your individual requirements. His suggestions are yours for the asking and may point the way toward a substantial increase in production economy.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

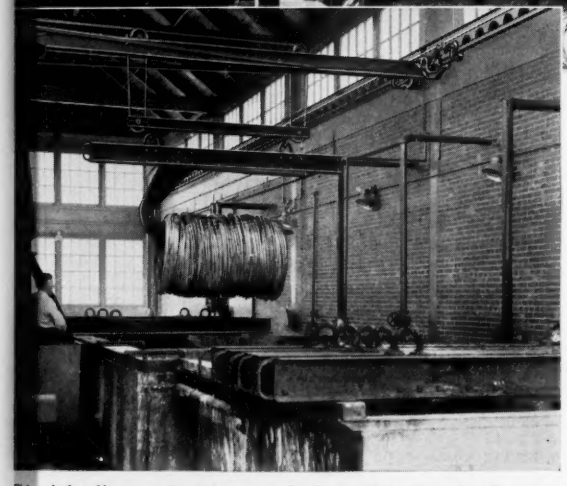
MODERNIZE YOUR WIRE AND ROD HANDLING METHODS

Cleveland Tramrail overhead materials handling systems make use of the ceiling and save valuable aisle space; they greatly increase efficiency of wire handling

WIRE and rod mills and wire products plants are learning that one of the most effective ways of reducing costs is by adopting modern overhead materials handling methods.

For many years Cleveland Tramrail has worked closely with the wire industry and has developed a complete line of equipment serving every department.

It will pay you to have a Cleveland Tramrail representative give you the details.



Straight-line production methods in the cleaning house made possible by Cleveland Tramrail, eliminate congestion and cut handling time

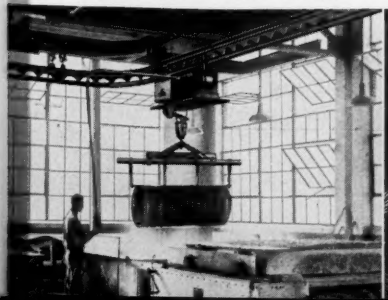
CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1141 Depot Street Wickliffe, Ohio

CLEVELAND TRAMRAIL

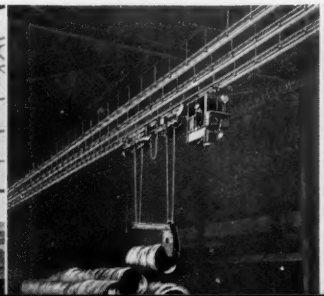
OVERHEAD MATERIALS HANDLING EQUIPMENT

Other products: CLEVELAND CRANES and STEELWELD MACHINERY

Hand or Electric Hoists and Carriers

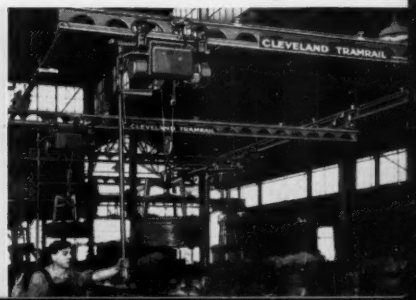


Hair Pin Hook Carriers



Cleaning House Cranes

Block Stripping Cranes and Hoists

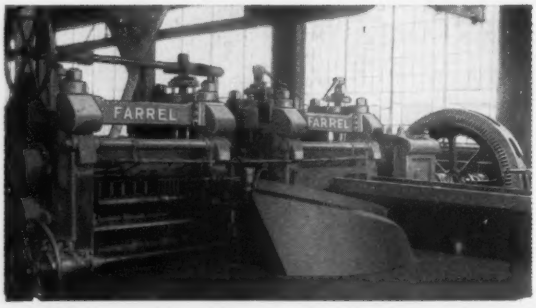


FARREL

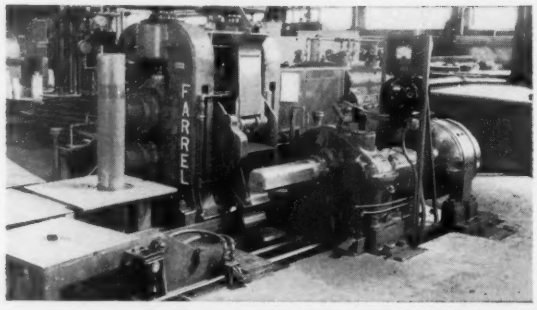
ROLLING MILL MACHINERY

ROLLING MILLS — For ferrous and non-ferrous metals. Complete rod mills from furnace to coilers.
ROLLS — Cupola and electric furnace chilled and alloy iron, heat treated Farrel Ni-Hard and steel.
ROD MILL TABLES AND MANIPULATING EQUIPMENT
UNIVERSAL MILL SPINDLES
ROD COILERS

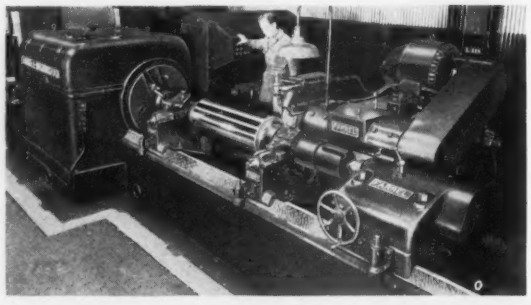
LEAD PRESSES for PIPE or ROD
ROLL GRINDING MACHINES
ROLL CALIPERS
CINDER CRUSHERS
GEARS
MILL PINIONS
PINION STANDS
GEAR DRIVES
FLEXIBLE COUPLINGS



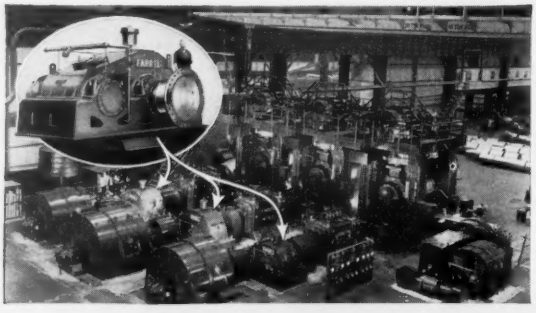
FARREL ROLLING MILLS are made for non-ferrous rods, strips or sheets and for cold strip steel. Built in a wide range of sizes, designed for any specific purpose to meet the demand for constantly increasing standards of quality at constantly decreasing cost of production.



FARREL CONSTANT TENSION REELS provide constant tension from empty to full reel, keep metal straight and flat, maintain uniform gauge. Various types to fit individual needs, all readily applied to your rolling mills.



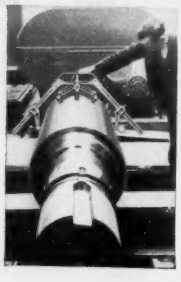
HEAVY DUTY ROLL GRINDERS—Specially designed for high output with high precision. Equally as efficient for heavy roughing or fine finishing on rolls of any material. Grinds perfect surfaces free of all marks, with concave, convex or straight contours of exact accuracy and symmetry. Six standard sizes for rolls in any length up to maximum diameters of 24", 28", 36", 44", 50" and 60".



FARREL GEAR DRIVES for rolling mill service are made in single, double and multiple reduction units, any ratio, any speed, any power. Designed to withstand the stresses, shocks and wear imposed by the heavy loads and high speeds encountered in the modern rolling mill.

NI-HARD ROLLS combine hardness of 80 to 90 scleroscope ("C" scale) with high strength and flawless surface. Ideal for high finish sheets, they produce a higher quality finish, have longer life and cut ton-cost of output.

ROLL CALIPERS are precision instruments designed for exact check of roll accuracy before removing from the grinder. Made in five sizes to measure rolls from 4" to 50" diameter.



FARREL

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

There's a big difference in Carbide Dies

Vascoloy
RAMET
TANTALUM-TUNGSTEN CARBIDE
WIRE DIES
COST
MUCH
LESS
IN THE LONG RUN

The Only Independent
Fully Protected by U. S. and Foreign Patents

VASCOLOY-RAMET CORPORATION
NORTH CHICAGO, ILLINOIS

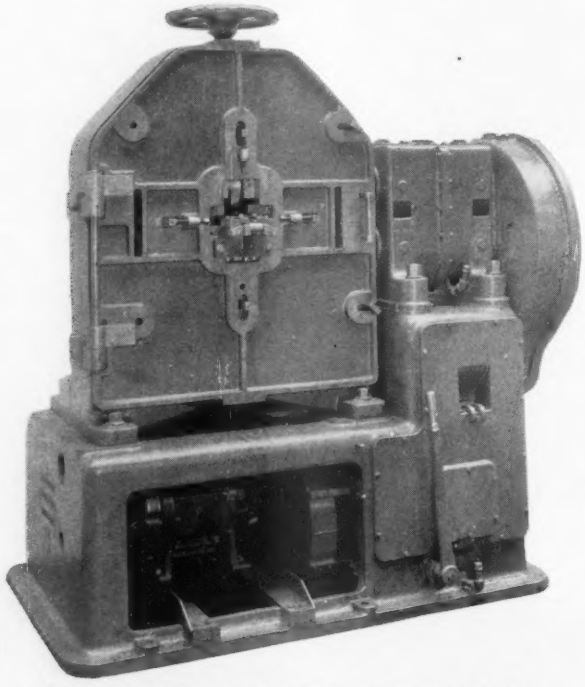
Pittsburgh, Pa. Detroit, Mich. Hartford, Conn. Jersey City, N. J.
In Canada: Carbide Tool & Die Company, Ltd., Hamilton, Ont.

COP-R-DRAW TUF-DRAW FER-O-DRAW

SOMETHING NEW AND BETTER!

THE FASTEST AND MOST ECONOMICAL METHOD OF FORMING SPECIAL SHAPES OF WIRE AND FOR EMBOSSING DESIGNS ON WIRE

THIS machine combines the functions of a wire drawing machine for pulling and for bundling the wire, but instead of the conventional type dies through which the wire is usually drawn it provides power driven rolls for reducing the stock. ✦ ✦ ✦



THE POWER DRIVEN PLAIN TYPE
(PATENTED)

THE **universal** type is used to convert round wire to rectangular sections, and the **plain** type, so-called, is used for forming special shapes of wire and also for embossing designs on wire.

✦ ✦ ✦

THE **universal** type has flat-faced rolls only. The **plain** type may have rolls formed for special shapes or rolls with designs engraved on them.

✦ ✦ ✦

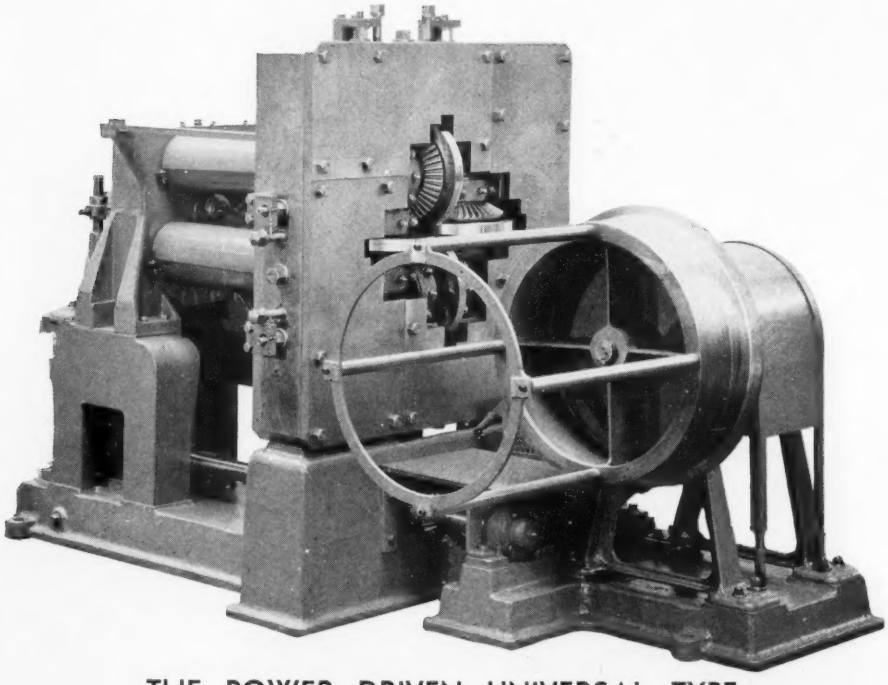
Write for Detailed Information

STANDARD MACHINERY CO.

PROVIDENCE, R. I.

PATENTED POWER DRIVEN "TURKS HEADS"

UNEQUALLED FOR CONVERTING ROUND WIRE TO RECTANGULAR SECTIONS AND FOR FORMING SPECIAL SHAPES

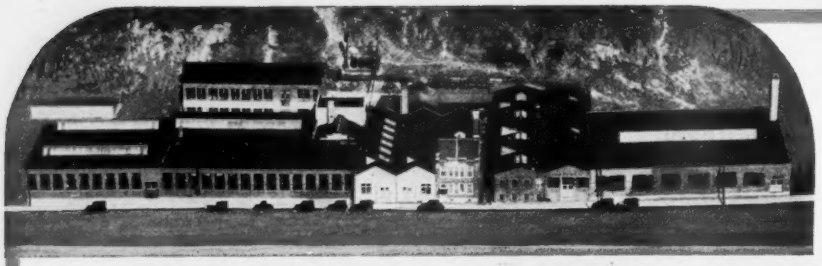


THE POWER DRIVEN UNIVERSAL TYPE
(PATENTED)

THIS machine combines the functions of a wire drawing machine for pulling and for bundling the wire, but instead of the conventional type dies through which the wire is usually drawn it provides power driven rolls for reducing the stock. ✦ ✦ ✦

Write for Detailed Information

STANDARD MACHINERY CO.
PROVIDENCE, R. I.



HUDSON WIRE CO. PLANT AT OSSINING, N. Y.

HUDCO

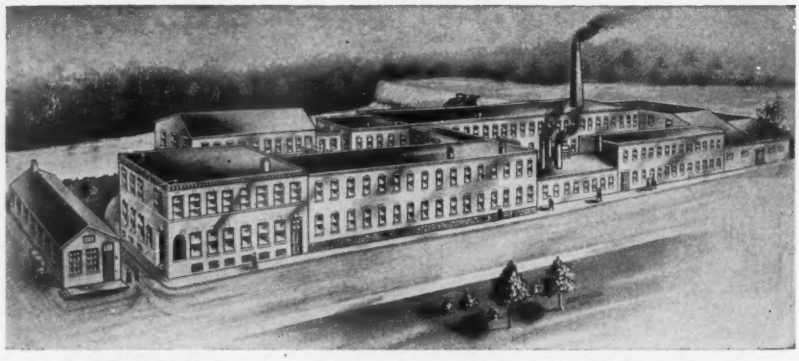
FINE WIRES IN ALL METALS

TWO MODERN AND COMPLETE WIRE PLANTS—— AT YOUR SERVICE——

LET US QUOTE ON YOUR WIRE REQUIREMENTS

WINCO

LEAKPROOF ENAMELLED WIRE



Winsted Divn. of HUDSON WIRE CO. at Winsted, Conn.

HUDCO

FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze, Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Tinsel Lahns, Silver Plated Copper, False Gold and Copper.

Cadmium, Nickel Silver, 10%, 18% and 30%; Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification, Metallic Fibre for Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum.

WIRES FOR METAL SPRAYING

Pure Lead, Lead Alloy, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire, High Conductivity, Electric Wire.

Cadmium, Nickel Silver, (10%, 18%, 30%); Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel, Commercial Bronze.

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from Selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing. BETTER WIRE AT LOWER COST.

LET US QUOTE

HUDSON WIRE COMPANY

OSSINING, N. Y.

SUCCESSORS ROYLE & AKIN

ESTAB. 1902 ESTAB. 1902

WINCO

LEAKPROOF ENAMELLED WIRES

Drawn from special oxygen-free copper that works so clean, so free from slivers, that enamelling is perfect. Leaks positively prevented. Every foot of WINCO enamelled wire is mercury tested before shipment to assure a wire perfect in every particular.

WINCO enamelled wire is covered to the same dimensions as fabric-covered wire so the user need not change his equipment. It will withstand softening in varnish-dipping and baking.

WINCO enamelled wire is lower in cost than silk covered wire. Write for sample.

LET US QUOTE

WINSTED DIVISION

HUDSON WIRE COMPANY

WINSTED, CONN.

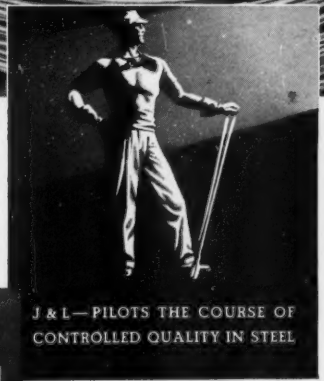
J&L *Mastercraft* SPRING WIRE SAVES TIME...TOOLS...MONEY

Under routine operating conditions, and using J & L Mastercraft Spring Wire, this automatic turns out 12,000 clutch springs every 8 hours, and better than 300,000 without a change of tools—that's production!

J & L Mastercraft Spring Wire runs through your automatics easily and uniformly. It does not score your wire guides, rolls, spreaders, mandrels, nose pieces or other tools, for its finish has been made to suit your shop conditions. It can be worked to the closest of tolerances and with a minimum of machine adjustment.

Drawn from J & L Controlled Quality (CQ) Steel, J & L Mastercraft Spring Wire has the stamina to do a job for you. Its use by hundreds of manufacturers for all types and sizes of springs proves its reliability under all kinds of shop conditions. Its fatigue-resisting properties mean long life springs—and completely satisfied customers for you.

Specify and use J & L Mastercraft Spring Wire—and get better springs—with greater savings.



J & L—PILOTS THE COURSE OF CONTROLLED QUALITY IN STEEL

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS
PITTSBURGH, PENNSYLVANIA

J & L—PARTNER IN PROGRESS TO AMERICAN INDUSTRY

• GOING TO PRESS-MARCH 1st, 1940 •

THE 1940 EDITION

of the

WIRE

& WIRE PRODUCTS'

Buyers Guide

and Year Book

of the

WIRE ASSOCIATION

The only reference book available listing all components of the wire industry, completely indexed.

Invaluable to purchasers of rod, strip, bare and covered wire and cable, cold drawn bars and cold headed products.

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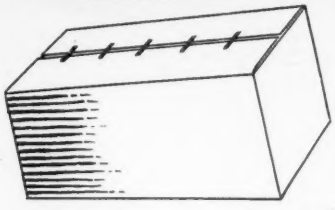

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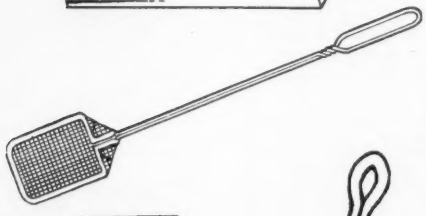

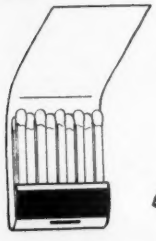

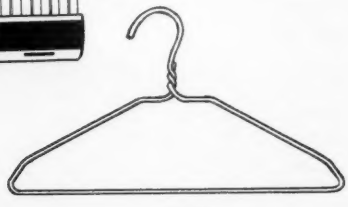

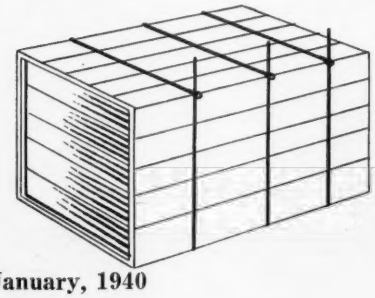

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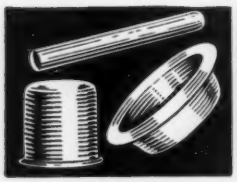

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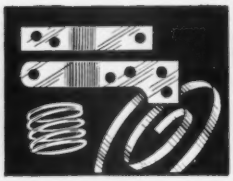

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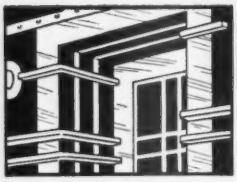

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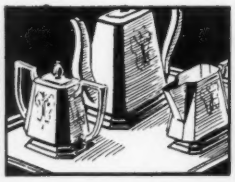

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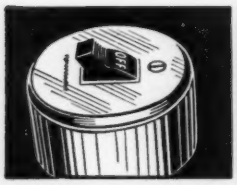

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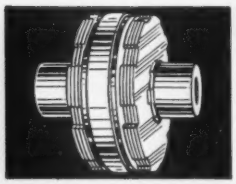

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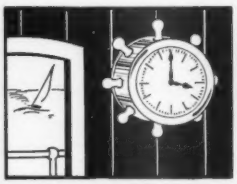

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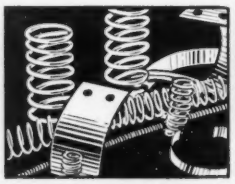

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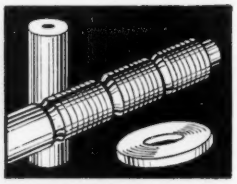

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DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 15 JANUARY, 1940 No. 1

Designated as

Official Publication By The Wire Association

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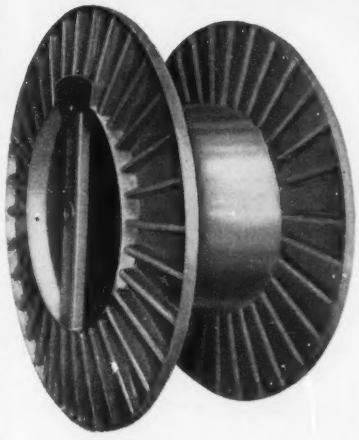

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Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 15 JANUARY, 1940 No. 1

A Correlation of the Factors and Effects of Cold Drawing of Wire Rods

Dr. S. A. Braley, A.B., A.M., Ph.D.,
Chief Metallurgical Field Engineer,
Pittsburgh Steel Co., Pittsburgh, Pa.

✦ ✦ ✦

THE MORDICA MEMORIAL LECTURE — 1939.

The Mordica Memorial Lecture Session was called to order at 4 p. m., Wednesday, October 25, 1939, Congress Hotel, Chicago, President F. A. Westphal presiding.

Mr. Westphal: As you know, we have created what we consider a very high honor in memorializing one of our Founders and first Presidents, that grand character, John Mordica, who left us July 3, 1937. He was a big part of the spirit of this Association. He gave it a lot of his time and ability and money and energies, and he was truly a great upbuilder of our Wire Association.

I had hoped that we could have one of his dearest and closest friends here today to introduce Dr. Braley—namely, Louis Winkler, of Bethlehem Steel Corp., but unfortunately Louis does not happen to be in Chicago at this time. Dr. Braley, I wish to express the appreciation of The Wire Association for the many months of research and effort and hard work on your part in preparing this first Mordica Memorial Lecture. As time goes on you will have the honor always of having been designated as the first lecturer on the Mordica Memorial Program. We certainly appreciate your efforts.

Gentlemen, at this time it gives me great pleasure to present to you the first Mordica Memorial Lecturer—Dr. S. A. Braley of the Pittsburgh Steel Company. Dr. Braley.

DR. S. A. BRALEY

Received A. B. degree at Morningside College in 1913, A. M., University of Illinois 1915, PhD., University of Illinois 1917. Instructor and Assistant Professor of Chemistry, University of Illinois 1917-1927. Pittsburgh Steel Company Fellowship at Mellon Institute of Industrial Research 1927 to date. Chief Metallurgical Field Engineer, Rod and Wire Division, Pittsburgh Steel Co., Pittsburgh, Pa. Member American Society for Metals, Wire Association.

THE development of the wire industry has been one of a retarded nature as compared with many of the other articles of commerce today. It is only in the last ten to fifteen years that real progress has been made in the manufacture and production of material for specific fabricating processes. Even with this development, very little has been published relative to the technical basis of wire production.

✦ ✦ ✦

IN the early beginnings of the industry, extremely small amounts of material were drawn by hand so that an elongated small section could be obtained. Dies were very crude and lubrication one about which no information was available. A wire drawer learned the art by apprenticeship and most certainly great credit is due those early artisans for the advances made with practically no technical

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IN MEMORIAM

JOHN MORDICA
1873 - 1937

training or advice. He learned to select his own rods, to pickle and lime them, to punch his own dies and to prepare his own lubricants, he was an artisan. In fact, even today some of the best information on technique available can be obtained from these same men.

✦ ✦ ✦

HOWEVER, as time has passed and developments have been made requiring certain definite physical properties in a certain material it has become necessary to materially alter this condition. The fabricator has at his disposal certain automatic machines, which while almost human, nevertheless, they do not have a brain to automatically adjust themselves to varying properties of the material fed to them. Their every operation is identical one with the next and if the material upon which they work is not identical, their product will vary as does the material supplied.

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THUS the entire trend of the industry has been to produce uniform material for each individual fabricator. As an illustration, I might present the following instance. Just recently, two individual fabricators were producing a part for the same consumer, but one was using a different chemical analysis and with different physical properties than the other. The tensile, for example, was approximately ten thousand pounds greater in one case. The fabricator using the higher tensile material could not use material produced for his competitor. On first consideration this seemed absurd since the function of the produced part did not require any appreciable strength to fulfill the function. Examination of the procedures proved the difference. One was using a hand forming operation, and the second a machine forming operation. The one using the hand forming could easily adjust himself to conditions but the machine forming could not without considerable expense for change of dies, etc.

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RECENTLY, **Mr. John H. Frye** of Columbia Steel and Shafting Company in an address before the York Chapter of the American Society of Metals (Reported in A. S. M. Review May, 1939) emphasized the importance of cooperation in designing, and in the proper selection of steel, stating that "one of the greatest wastes in industry is the misapplication of steel. Proper application can only be made through complete collaboration of the designer, the metallurgist, the purchasing agent and the source of supply".

✦ ✦ ✦

THESE facts together with the development of modern machinery and equipment have thus taken the art out of wire production and placed it on a scientific basis. In reality, the wire drawer is an operator. His steel is selected for him, of necessity because ultimate physical and chemical properties are desired, his rods are cleaned and limed for him, because certain final finishes are desired, his dies are cut because the dies used require special operations of machining and polishing, and his lubricants are prepared because again certain finishes and uniformity of finish are demanded.

✦ ✦ ✦

THUS with these changes and necessity for cooperation between producer, designer and consumer, it is extremely necessary that basic knowledge of the effects of certain operations, etc., be at hand.

✦ ✦ ✦

IT has often been said that steel is a temperamental thing, and you cannot produce it within certain ranges which have been excessively large. Also, that you never know what is going to happen because you use the same technique and get different results. This conception is, of course, false because things or results do not just happen—they are caused, and if an operation is carried out identically the same on identical material an identical result will be obtained, and if it is not obtained, it will be because there are variables about which nothing is known, or which has not been considered in the supposedly identical procedure.

IT is true that certain operations in the production of steel are of such magnitude that absolute control with our present day knowledge is practically impossible. Therefore, it rests upon the processor to have a knowledge of these variations and so adjust his operations to smooth them out and produce a uniform product and not assume that such things are beyond control.

✦ ✦ ✦

UNDER present day production let us consider some of these variables. First, **method of production, acid and basic open-hearth, bessemer and electric steel** —these in themselves are used to produce certain characteristic materials and to overcome certain deficiencies of one operation by another. Second, **chemical analysis** (and we will confine our remarks to regular Carbon steels)—Carbon may vary from practically 0.0% up to eutectic steel, and in many instances above with also many variations in the other elements; namely, Manganese, Sulphur, Phosphorus and Silicon. Today, with the large amount of Alloy steels being used, new variables are being introduced. First of these is Copper, which because of the large amount of Copper bearing steel that reverts to new production through the medium of scrap is continually increasing, and more and more becoming a factor in controlled production. In other words, the trend is toward production of all Copper bearing steel. The same is true of other elements such as Nickel and Chromium, while not at the present time having much effect, they are on the increase.

✦ ✦ ✦

LET us look farther, this time eliminating many of the variables of steel production by confining ourselves to the Basic Open-Hearth process. In the working of a heat, vast differences are, of course, produced by type of scrap, etc., and the method of working the heat. However, a great variable is the method of killing and the oxide control of the slag blanket.

COUPLED with these are the features of grain size, each of which must be ultimately taken into account in the final processing. Another is the means of casting, which may be a killed ingot with or without a hot top, or a capped ingot, or a top or bottom cast rimmed ingot. These all produce characteristic conditions. The amount of segregation varies, e.g., the Carbon in a bottom cast rimmed ingot may vary 5 or 6 points of Carbon from top to bottom; whereas, a top cast rim will be only 3 or 4 points, and a Capped Steel 2 or 3, and with a Killed Steel only about one point. These factors are, of course, dependent upon degree of oxidation of the heat, and the temperature and speed of casting.

✦ ✦ ✦

SUBSEQUENT to these operations and their variables are the further complication of rolling with the resultant effects of temperature during same, and the finishing temperature obtained.

✦ ✦ ✦

BEING cognizant then of the vast number of variables present, let us look upon some method of attempting to correlate certain definite combinations of these with physical properties of resultant cold worked material. Let us look first upon the effect of chemical analysis on tensile strength. Several methods of prediction have been used. We will here consider that of the late Prof. Campbell of Michigan which is stated as follows:—37,430 + 95 C. + 8.5 Mn. + 105 P. + R. in which the symbols C, Mn. and P. represent the percentage of each with the unit .001 being used as one. Thus .10 C. becomes 100 times 95 or 9,500#, etc. As an example, an analysis .10 C., .40 Mn., .015 P., would give a result as follows:

37,430
9,500=.10 C.
3,400=.40 Mn.
1,575=.015 P.

51,905=Total Tensile Strength

✦ ✦ ✦

HOWEVER, the R of the formula represents a correction factor for those conditions or elements not known. This also applies to the normal hot rolled or annealed condition. We have found that this value holds very closely if values are added for such other elements as Copper and Silicon which may be substituted for the R. The values for each of these being 25, thus making the amended formula read:—

37,430 + 95 C. + 8.5 MN. + 105 P. + 25 Si. + 25 Cu.

with the additional stipulation that not more than .25% Cu. be considered. In some instances Copper is used around 1.0% or more, and these steels go into the Alloy class, and present further difficulties.

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IT is also important to note that the value .25 Cu. is that value which supposedly represents the maximum for corrosion resistance and amounts above this have little or no effect, or may even be detrimental. Thus these values are a correlation of effect of Cu. in two directions.

✦ ✦ ✦

AS a second example, we may use a spring grade of steel as follows:

.60 C. 1.00 Mn., .015 P., .06 Cu. .15 Si.

giving a resulting calculated tensile value of:—

37,430
57,000= .60 C.
8,500=1.00 Mn.
1,575= .015 P.
1,500= .06 Cu.
3,750= .15 Si.

109,750=Total or Basic Tensile.

✦ ✦ ✦

WITH these two analyses in the hot rolled condition the former or low Carbon material will check very closely with the value given; whereas, the high Carbon material will usually be much higher due to the temperature of finishing of the Rod and the amount of water applied, etc. However, if the sample be carefully annealed without spheroidizing, the result will be very close.

✦ ✦ ✦

SINCE we then have an apparent base relationship between the physical and chemical analysis of the steel, we have a base upon which to work for prediction of other factors.

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LET us next look upon the effect of cold work on low Carbon Steels. Whenever drawing a Rod to Wire a certain amount of reduction is taken, thus elongating the piece and reducing its cross-section. Several methods of calculating or reporting this may be used. The first or older method is that of the number of gauges, or the number of thousandths reduced. A second method is that used by Bonzel and reported in Lewis' translation of his book which is percentage elongation and, of course, is a direct function of the percentage reduction. Hence, either of these methods may be used, but we have chosen to use percentage reduction.

✦ ✦ ✦

IT is generally known that a given chemical composition with a given method of heat treatment produces the same microstructure, and the same physicals in the annealed condition. This physical structure and combination of elements also imparts definite hardness to the resulting material. With these conditions existing, it is also reasonable to assume that for a given amount of distortion that a definite relative amount of change of these properties would result.

✦ ✦ ✦

BONZEL states that the change in tensile strength for each percent of elongation for various grades of Wire is as follows:—

Mild rimmed steel —480# per square inch
Mild steel killed with silicon —620# per square inch
High Carbon Steel —700# per square inch

✦ ✦ ✦

HOWEVER, for direct determination of the values four (4) steels were drawn varying percentages and the physicals taken at each draft. Table I to IV shows the resultant values.

✦ ✦ ✦

THE value of F varies with type of steel and for low Carbon rimmed steel is 1.4; for capped steel 1.5 and for medium Carbon 1.2.

TABLE I

1010 Rimmed Steel
Analysis C. .075 - Mn. .27 P. .012 - S. - .028 Cu. .10
Basic Tensile calculated 50,600#

DRAFT	WIRE DIA.	NECK DIA.	% R. A.	TENSILE	CALC. TENSILE	ROCKWELL
0	.362"	.1835"	74.2	52,200#	50,600#	B 43.5
5	.348"	.1935"	69.2	68,000#	54,400#	75.5
10	.342"	.196"	67.0	70,500#	58,200#	75.5
15	.332"	.1965"	64.5	74,800#	62,000#	80.5
20	.320"	.192"	64.0	77,200#	65,800#	84.0
25	.310"	.1885"	62.9	80,900#	69,600#	84.0
35	.290"	.1775"	62.5	83,700#	77,200#	84.5
50	.254"	.1655"	57.5	92,500#	88,600#	87.0
60	.227"	.150"	56.2	97,800#	96,100#	92.5
75	.179"	.1275"	49.2	115,000#	107,500#	93.5

TABLE II

1020 Rimmed Steel
Analysis C .17 - Mn. .73 P. .013 S. .028 Cu. .10
Basic Tensile 63,650#

DRAFT	WIRE DIA.	NECK DIA.	% R. A.	TENSILE	CALC. TENSILE	ROCKWELL
0	.363"	.202"	69.0	62,200#	63,250#	B 66
5	.349"	.205"	65.5	73,100#	68,450#	B 78
10	.342"	.2075"	63.1	77,400#	73,150#	B 83
15	.333"	.204"	62.4	79,400#	77,950#	B 84
20	.321"	.202"	60.6	85,400#	82,750#	B 85
25	.311"	.201"	58.2	84,200#	87,550#	B 85
35	.291"	.1935"	55.8	89,500#	97,050#	B 87
50	.255"	.180"	50.2	103,000#	111,400#	B 90
60	.227"	.1675"	45.6	105,000#	121,000#	B 91.5
75	.179"	.139"	39.7	123,000#	135,000#	B 93

CURVES SHOWING RELATION OF TENSILE STRENGTH, NECK AREA AND PERCENT REDUCTION IN AREA TO DRAFT FOR 1010 WIRE

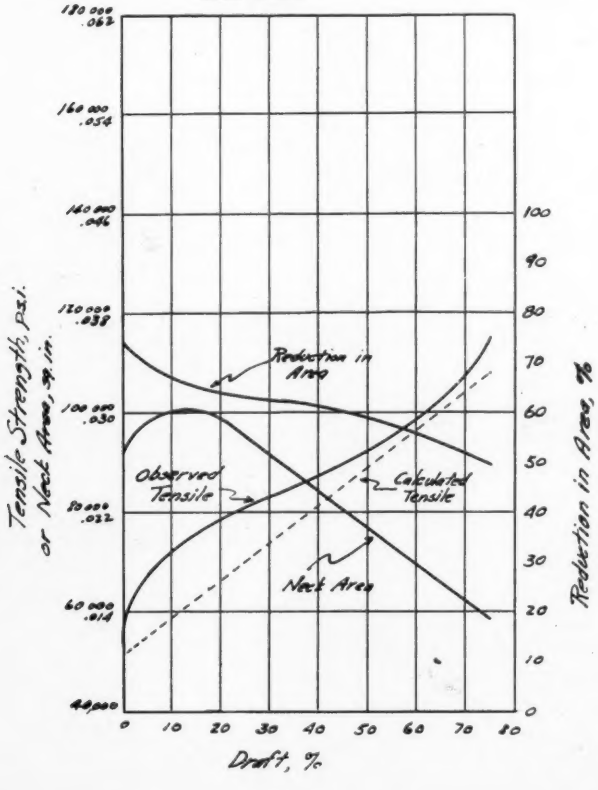


Fig. 1.

CURVES SHOWING RELATION OF TENSILE STRENGTH, NECK AREA, AND PERCENT REDUCTION IN AREA TO DRAFT FOR 1020 WIRE

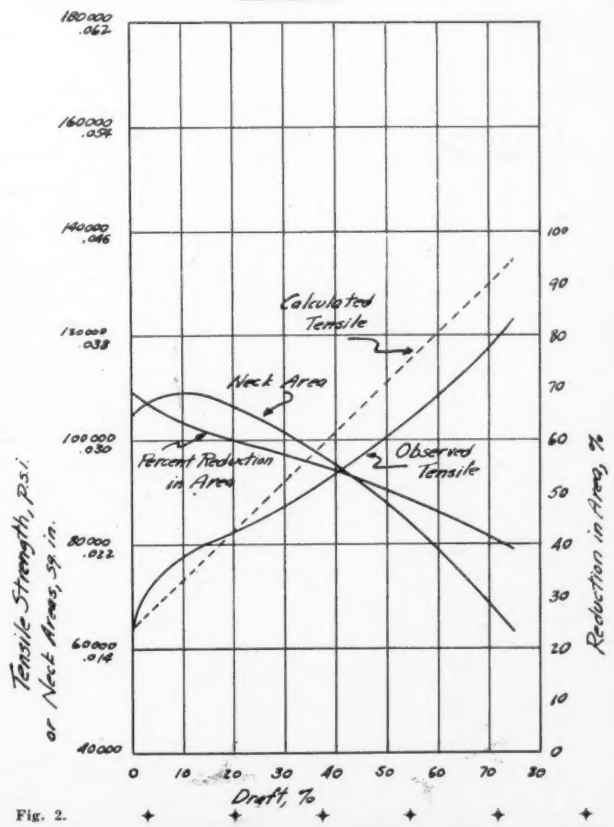
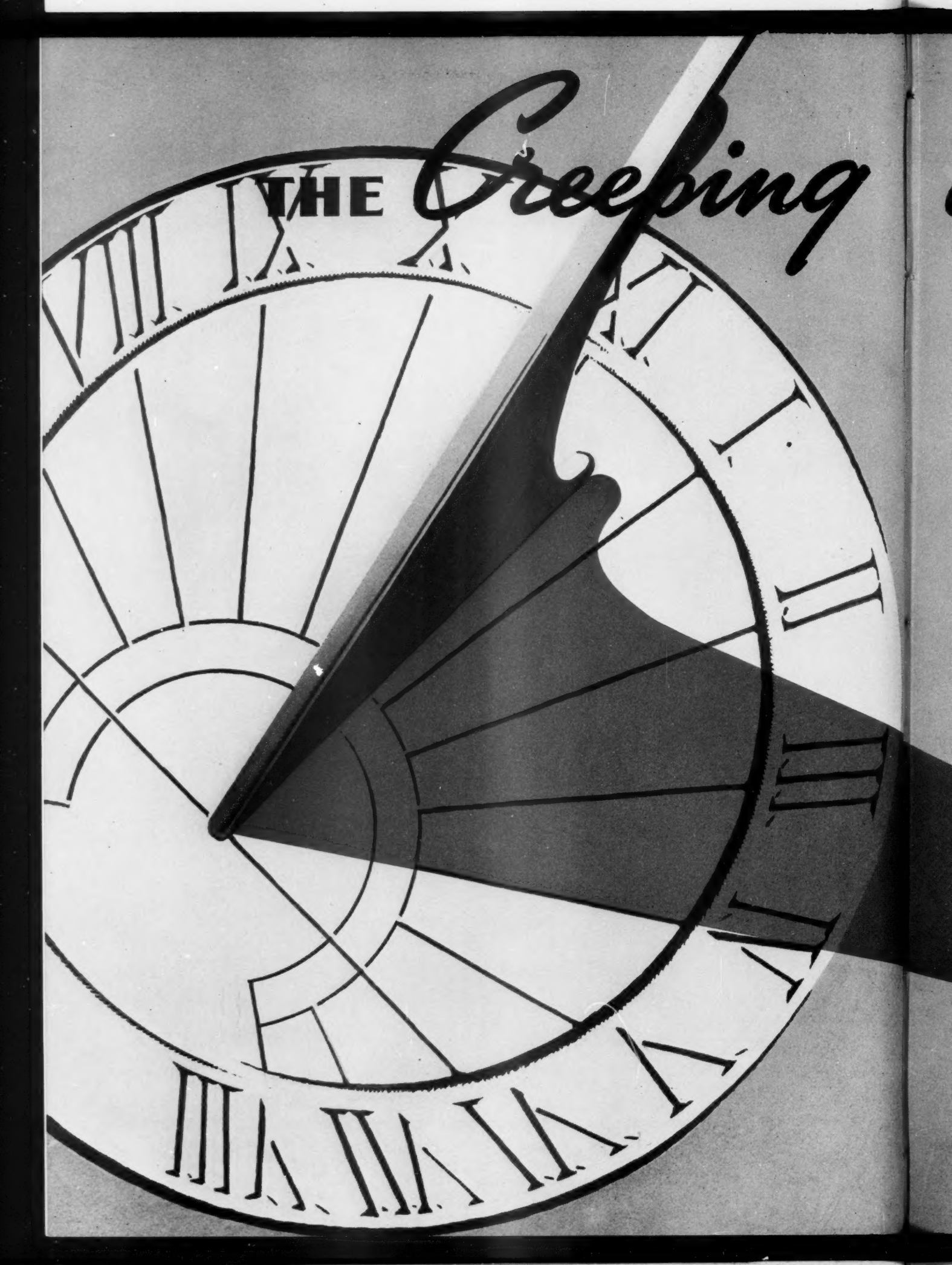


Fig. 2.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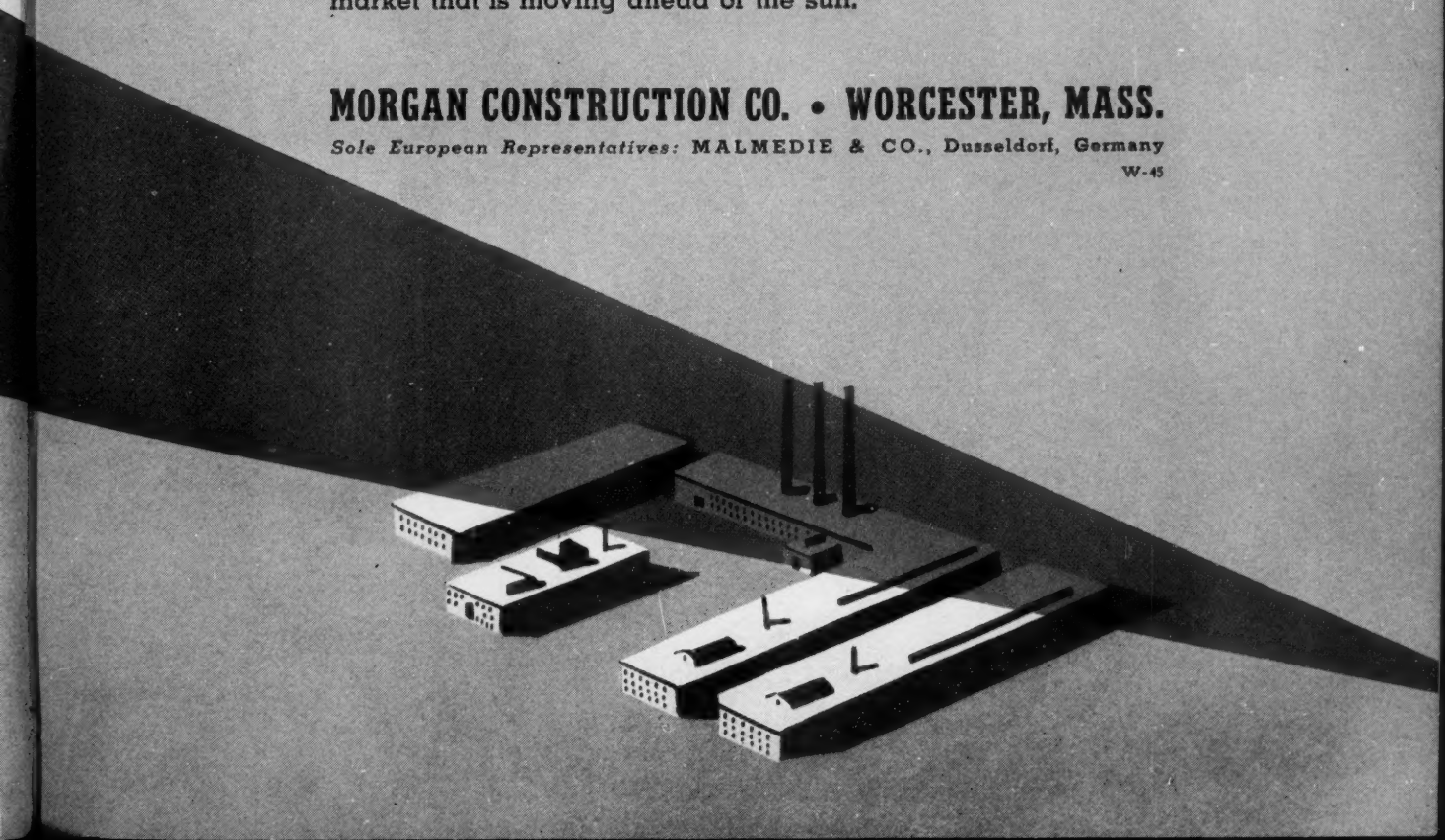

TABLE III
1035 Steel Green
Analysis C. .38 Mn. .95 P. .020 S. .033 Si. .19 Cu. .10
Basic Tensile 90,955#

DRAFT	WIRE DIA.	NECK DIA.	% R. A.	TENSILE	CALC. TENSILE	ROCKWELL
0	.366"	.2365"	60.0	94,400#	90,955#	B 82
5	.350"	.2435"	51.6	105,000#	96,400#	B 94
10	.343"	.239"	51.5	109,000#	102,000#	C 14
15	.333"	.2365"	49.5	116,000#	107,000#	C 15
20	.321"	.235"	48.5	122,000#	113,000#	C 16
25	.312"	.230"	46.7	124,000#	118,000#	C 17.5
35	.291"	.2210"	42.0	132,000#	129,000#	C 17.5
50	.255"	.1995"	38.7	147,000#	146,000#	C 21
60	.228"	.1855"	33.5	156,000#	156,000#	C 23
75	.179"	.149"	30.9	179,000#	173,000#	C 26

TABLE IV

1035 Normalized Steel
Analysis C .34 Mn. .89 P. .017 S. .030 Si. .17 Cu. .10
Basic Tensile 86,355#

DRAFT	WIRE DIA.	NECK DIA.	% R. A.	TENSILE	CALC. TENSILE	ROCKWELL
0	.367"	.226"	62.1	84,300#	86,400#	B 79
5	.349"	.2365"	54.0	99,500#	91,600#	B 92
10	.342"	.234"	53.3	102,000#	96,800#	C 13.5
15	.333"	.229"	52.9	107,000#	101,900#	C 13
20	.321"	.227"	50.1	115,000#	107,100#	C 14.5
25	.312"	.2235"	48.7	116,000#	109,700#	C 15
35	.291"	.2155"	45.2	122,000#	122,700#	C 16.5
50	.255"	.201"	38.0	135,000#	138,200#	C 18
60	.228"	.1805"	37.7	150,000#	148,600#	C 22
75	.179"	.1485"	31.3	170,000#	164,100#	C 24

These data are plotted in Figures 1 to 4 inclusive, and indicate the relationship of these factors relative to draft. The dotted line indicates the calculated tensile on the basis of the following formula:—

$$T = BT\ (1 + D \times F)$$

in which T represents ultimate tensile, B.T. the basic tensile by calculation as indicated above, D the percentage of draft and F a factor applicable to the grade of steel.

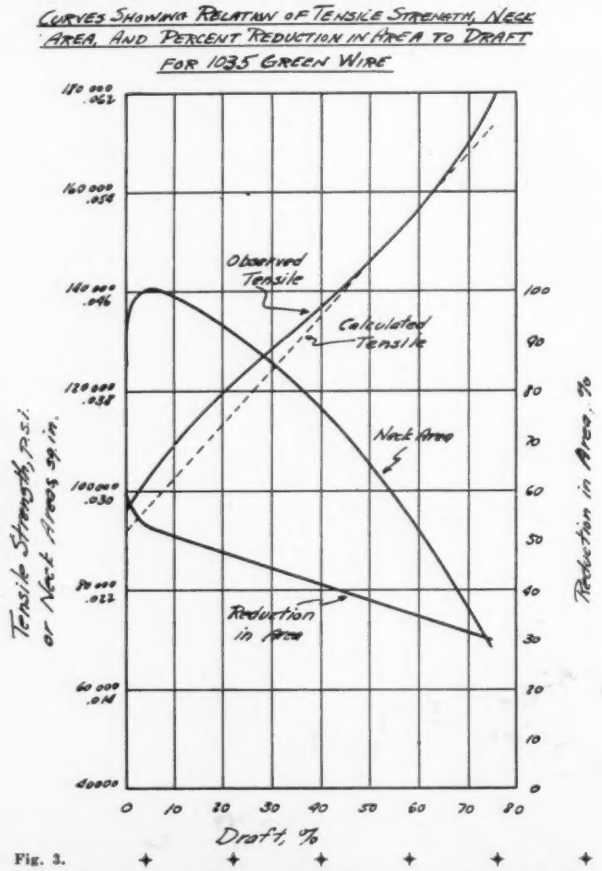
Curves Showing Relation of Tensile Strength, Neck Area, and Percent Reduction in Area to Draft for 1035 Green Wire
Observed Tensile
Calculated Tensile
Neck Area
Reduction in Area
Tensile Strength, p.s.i. or Neck Area, sq. in.
Reduction in Area, %
Draft, %

Fig. 3.

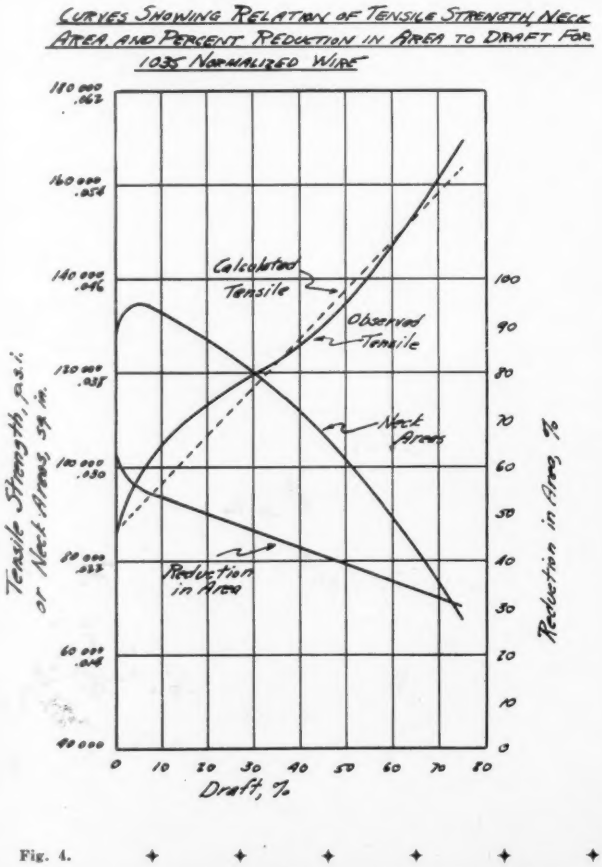
Curves Showing Relation of Tensile Strength, Neck Area, and Percent Reduction in Area to Draft for 1035 Normalized Wire
Calculated Tensile
Observed Tensile
Neck Area
Reduction in Area
Tensile Strength, p.s.i. or Neck Area, sq. in.
Reduction in Area, %
Draft, %

Fig. 4.

IT will be noted from Table I and Figure I that considerable discrepancy exists between the determined and calculated tensile; however, it has been noted that the initial draft from a Rod has the greatest effect on this property, and a higher tensile is obtained if a total of say 20% is taken in one or three or four drafts. Bonzel presents data showing a difference of 5,000# when 51% draft is taken in 2 or 5 steps; of 13,000# when 91% is taken in 6 or 16 drafts, and since a draft of less than 15% or 20% is rarely used in commercial practice much closer agreement is obtained. This factor also appears greatest in the lower Carbon steels. No explanation is advanced for this fact.

✦ ✦ ✦

FIGURE 5 shows this composite relationship on these steels and it should be noted that the relative shape of the observed curves are very similar, in each instance the observed values being higher than the calculated values in the low percentage drafts and lower in the higher percentages.

✦ ✦ ✦

A COMPARISON of values may be made with Bonzel's values on the basis of 480# per square inch per percent elongation for low Carbon Rimmed Steel as shown in Table V.

✦ ✦ ✦

BY these comparisons it should be noted that agreement between my calculated values and Bonzel's is very good up to 50% draft, also that Bonzel's are almost as close in agreement with the observed, but at 75% draft his values are very far from observed values. However, Bonzel states that these values apply only for the first three drafts, but if each are taken at 35% this represents a total draft of 73.5%.

✦ ✦ ✦

FIGURE 6 represents the reduction of area of these same steels with varying drafts, and the values are correlated in Table VII, on the next page.

✦ ✦ ✦

THUS it is indicated that as is generally known the reduction of area is a factor proportional to grade of steel and to amount of cold work, and also that the change of the value with drafting is proportional to the original variations.

TABLE V*

% Draft	% Elongation	Observed Tensile	Braley	Bonzel
10	11	70,500#	58,200#	57,480#
20	25	77,200#	65,800#	64,200#
25	33	80,900#	69,600#	68,040#
35	53	83,700#	77,200#	77,640#
50	100	92,500#	88,600#	100,200#
75	300	115,000#	107,500#	196,200#

***Data from Table I.**

For the medium Carbon or 1035 Normalized Steel, and using data from Table IV with Bonzel's value of 620# per square inch per percent elongation, we have the comparison in Table VI; as follows:—

TABLE VI

% Draft	% Elongation	Observed Tensile	Braley	Bonzel
10	11	102,000#	96,800#	91,120#
20	25	115,000#	107,100#	99,800#
25	33	116,000#	109,700#	104,760#
35	43	122,700#	122,000#	110,760#
50	100	135,000#	138,200#	146,300#
75	300	170,000#	164,100#	270,300#

ANOTHER fact here presents itself, namely, the relationship between break strain change and neck area change with drafting. Table VIII presents the determined

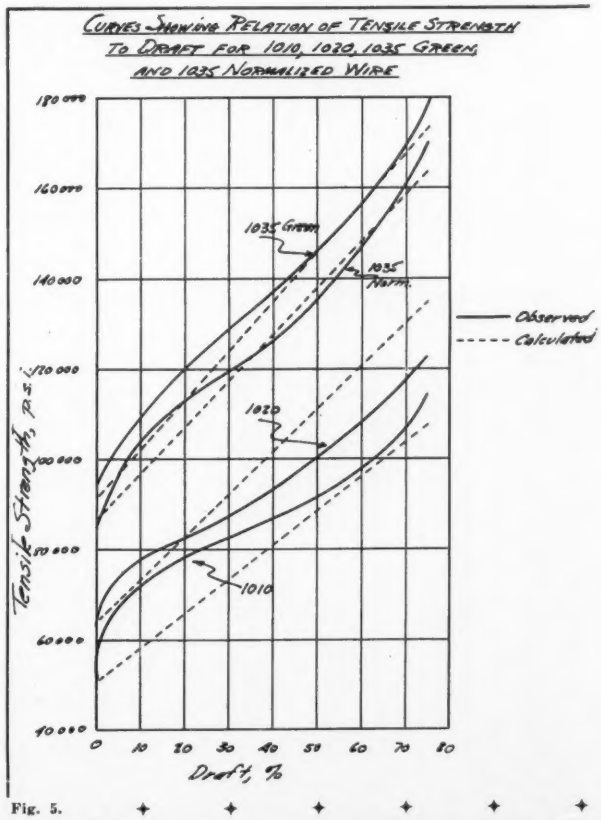

Fig. 5.

TABLE VII

% DRAFT	1010	1020	1035 GREEN	1035 NORMALIZED
0	74.2	69.0	60.0	62.1
5	69.2	65.5	51.6	54.0
10	67.0	63.1	51.5	53.3
15	64.5	62.4	49.5	52.9
20	64.0	60.6	48.5	50.1
25	62.9	58.2	46.7	48.7
35	62.5	55.8	42.0	45.2
50	57.5	50.2	38.7	38.0
60	56.2	45.6	33.5	37.7
75	49.2	39.7	30.9	31.3

TABLE VIII

% DRAFT	BREAK STRAIN			
	1010 Determined	1020 Determined	1035 Green Determined	1035 Normalized Determined
0	5363	6440	9885	8915
10	6468	7110	10105	9375
20	6200	6930	9925	9350
25	6100	6386	9515	8816
35	5523	5950	8803	8170

break strain on each of these steels for the first 35% draft.

✦ ✦ ✦

THESE data indicate an increase of break strain of the wire even though there is a decrease in area. A correlation with this fact is evidenced by the neck areas as shown in Fig. 7. It should be noted that the neck area likewise increases in area and then decreases. The point at which the neck area becomes the same as or less than the original area corresponds with the percentage draft at which the break strain is equal to or less than the original break strain. Also it should be noted that with 1010 steel this occurs at about 35% draft, for 1020 between 25% and 35% draft, and for the 1035 steels at about 20%.

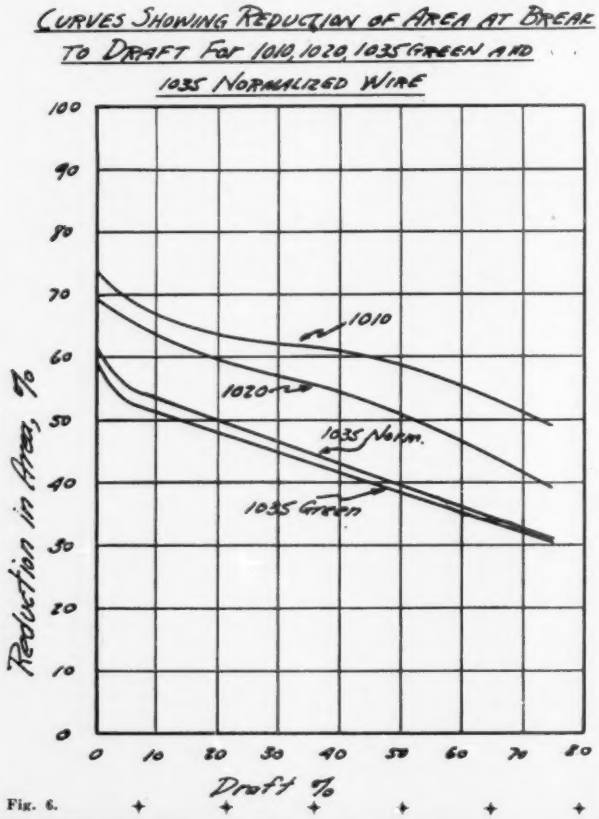

Fig. 6.

✦ ✦ ✦

THERE has been a great deal of contention as to necessity of normalizing 1035 steel for cold heading. I believe it is general practice in drawing cold heading stock to take a 1/32" draft from the rod. The percentage draft then becomes 12.4%, 16.4% and 23.8% from ½", ⅜" and ¼" rods respectively. Thus the standard draft of 16.4% coincides with the factor above and may be indicative as to why 1035 steel rods for cold heading in sizes ⅜" or smaller should be heat treated to increase their plasticity.

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IN Table IX, on next page, are shown the properties of these steels when the tensile strength is almost identical.

✦ ✦ ✦

THESE values would indicate that for a given tensile the plasticity as measured by R. A. is identical; however, these values are all based on starting with the same size Rod. In another set of data different size Rods have been so drawn that at a given size they all have the same tensile but the R. A. varies inversely as the percentage draft.

✦ ✦ ✦

THESE data are shown in Table X, on next page.

✦ ✦ ✦

THESE data then appear to contradict those of Table IX but in this case the size remains constant, and the draft has varied so as to produce the same tensiles. The variation in % R.A. is favorable to the higher basic tensile material.

✦ ✦ ✦

WHAT effect then do these facts have on material specifications? From Table X we see

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that the R.A. of the 1035 N Steel is much greater in the same size wire and with approximately the same tensile and Rockwell than even the originally much softer material 1010. Furthermore, it has only received 10% of cold work whereas the 1010 has received 60% cold work. Thus it should be self-evident that for many applications the 1035 N or the 1025 would be preferred.

✦ ✦ ✦

THUS we see that the Basic Tensile of a piece of Rod can be predetermined from its chemical analysis and that its change of tensile with cold work is a direct function of the percentage of draft, and the basic tensile value.

✦ ✦ ✦

KNOWING then that these variations exist, what then should be a maximum anticipated variation in tensile on a normal grade of steel? Let us take a 1015 steel, the specified range of analysis being C. .10 — .20, Mn. .30 — .60, P. .04 max., S. .04 max. Considering the Phosphorus constant at .02 and adding a constant Copper content of .03, we should then have a maximum and minimum tensile in the Rod of 66,100# and 54,000#, respectively. This does not take into account the variations in the cast of the heat, but assumes that it is all true to ladle values.

✦ ✦ ✦

ROD tolerances are ± 1/64" with an out of roundness of .025". A 7/32" rod could then be round at .233" or .203" and be within specification. If we now use the large size rod with the high side of the analysis, and the small rod with the low side of the analysis to make a 10 ga. wire, we would expect a variation of from 99,000# to 130,000# plus the additional variation due to heat segregation. If this condition of rod and analysis is reversed values of 107,000# and 120,000# should result. The normal fluctuations in the segregation will add another ± 5,000#, giving a total overall variation of 41,000#. According to the Steel

TABLE IX

GRADE	TENSILE	SIZE	% DRAFT	% RA	ROCKWELL
1010	80,000#	.310"	25.0	62.9	B 84
1020	80,000#	.321"	20.0	62.4	B 84
1035 N	84,300#	.367"	0.0	62.1	B 79
1035 G	94,400#	.366"	0.0	60.0	B 82
1010	98,000#	.227"	60.0	56.2	B 92.5
1020	103,000#	.255"	50.0	50.2	B 90.0
1035 N	102,000#	.342"	10.0	54.0	B 92.0
1935 G	105,000#	.350"	5.0	51.6	B 94.0
1010	115,000#	.179"	75.0	49.2	B 93.5
1020	123,000#	.179"	75.0	39.7	B 93.0
1035 N	115,000#	.321"	20.0	50.1	C 14.5
1035 G	116,000#	.333"	15.0	49.5	C 15.0

TABLE X

Grade	B. Tensile	Size	Tensile	% Draft	% R.A.	Rockwell
1010	51,385#	.186"	94,600#	60	56.6	81.5
1015	56,280#	.186"	92,500#	47	61.7	74.4
1025	66,155#	.187"	93,000#	29	64.5	81.6
1035 N	78,200#	.186"	87,700#	10	69.0	80.9

CURVES SHOWING RELATION OF NECK AREA TO DRAFT FOR 1010, 1020, 1035 GREEN AND 1035 NORMALIZED WIRE

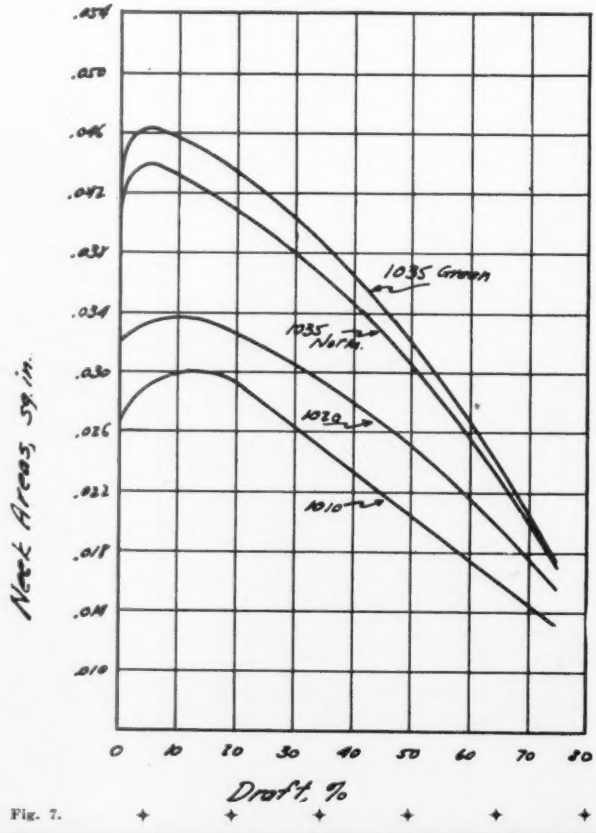

Fig. 7.

✦ ✦ ✦ ✦ ✦ ✦

Products Manual of the Iron and Steel Institute, the standard allowable variation for material below 120,000# is 20,000#, and for 120,000# to 240,000# is 35,000#. These tolerances are entirely satisfactory for a given heat of steel but certainly are at a minimum according to steel grade and rod specification. Thus fabricators asking for lower specifications are requesting specialty materials which require special selection of heats or special methods of processing. Hence, use of such data as presented above are essential for such specialties.

✦ ✦ ✦

UNDOUBTEDLY many questions arise as to the effect of speed, lubrication, die shape, etc., and in this we agree with Giraud (Revue de Metallurgie 1928 nos. 4, 5 and 6,) and with Bonzel that they have no effect.

ANOTHER factor, namely, that of electrical conductivity is of importance in production of telephone wire since the various grades are based on the mile Ohm. resistance. Again electrical resistance should be a function of composition. If this assumption is correct, it should then be proportional to the numerical value of this composition expressed in terms of tensile strength. The following formula will then represent the resistance of a given wire:—

$$R = \frac{BT}{1000} \times \frac{K}{A}$$

in which R is resistance in Ohms. BT is calculated Basic Tensile, A, area of the wire and K an empirical constant which has been determined to be .00603. This value will probably somewhat differ for different types of steel production, but for those steels produced which will produce BB and EBB wire, it applies very closely. It should be noted that the determined tensile of the wire is not included in the formula as cold work hardness seems to have no effect.

✦ ✦ ✦

THIS presentation has been presented in an attempt to demonstrate a possible feasible method of simple prediction of properties of some low and medium Carbon steels and the possible application of these properties to fabricating processes. Heat treatment, of course, changes many of these factors, but since this is indeed a problem of its own it has not been dealt with in this discussion. However, it may be added that heat treatment does change these properties in a perfectly orderly manner. The speaker realizes that many of these property effects are well known but to his knowledge have not been predictable on a simple basis. Too often they are not taken into ac-

(*Please turn to Page 77*)

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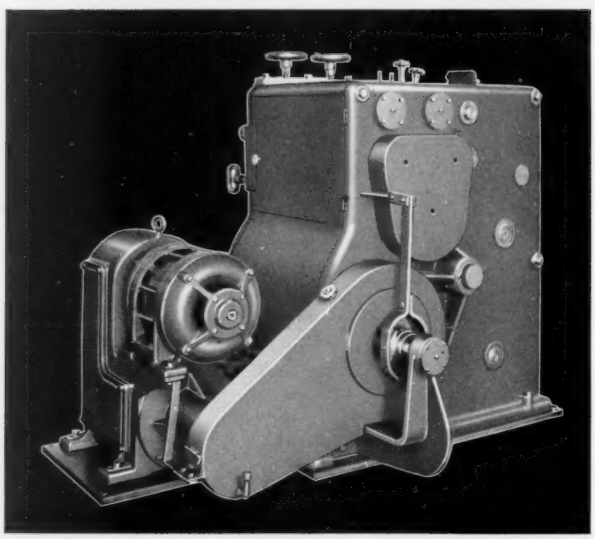

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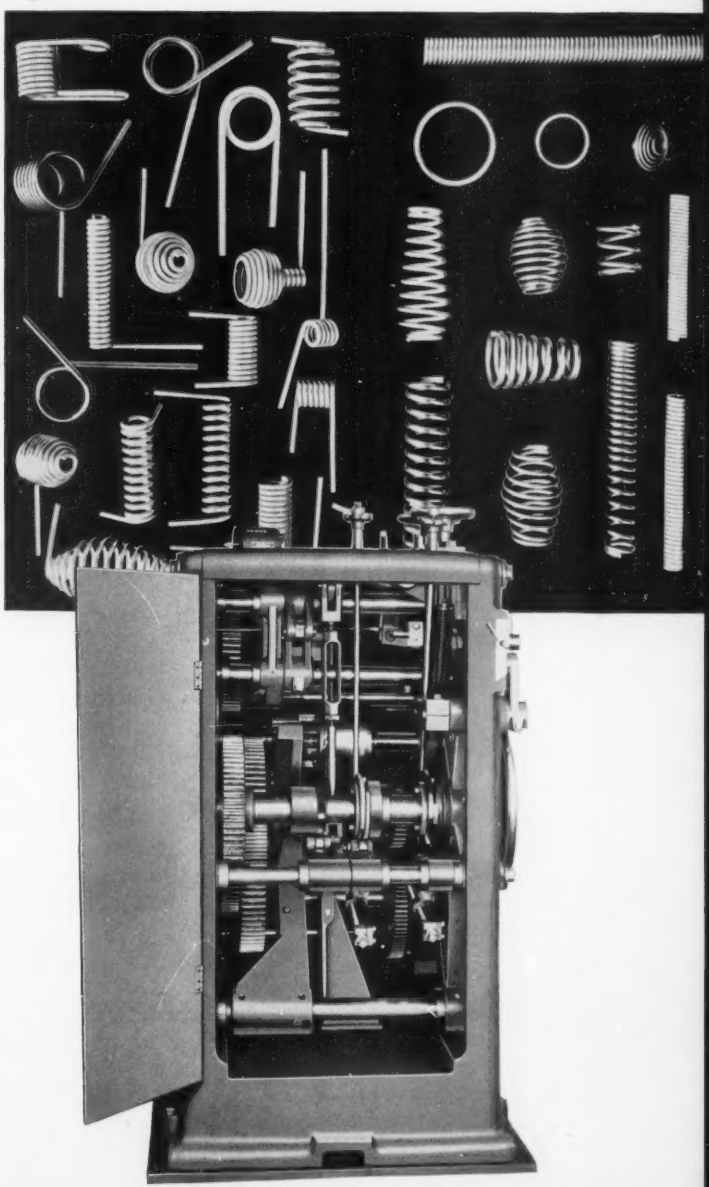

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The Disposal of Waste Acids

By Dr. W. W. Hodge,
American Iron and Steel Institute, Research Fellow,
Mellon Institute of Industrial Research, Pittsburgh, Pa.

A survey of the disposal of waste pickle liquors together with an outline of the experimental research work done through the establishment of a Fellowship for this purpose at the Mellon Institute of Industrial Research by The American Iron and Steel Institute. A lecture presented before The Wire Association Convention, October, 1939. ✦ ✦ ✦

Introductory

THIS waste pickle liquor problem is a good deal like the poor; it is always with us. I found some English patents going back to 1888; hence for over fifty years, men in the iron and steel industry have been endeavoring to solve this problem.

✦ ✦ ✦

AT a conference with sanitary engineers and chemists of the Chicago Sanitary District last year, one of the engineers handed me a bulletin published by the U. S. Geological Survey, describing a study of stream pollution in Ohio and the installation of a process for treatment of the acid wastes from the iron works, dated 1906; so, thirty-three years ago we were working on the problem, even in this country.

✦ ✦ ✦

IN the survey we have made preliminary studies on some twelve methods of disposal of waste pickle liquor without recovery of any by-products, and forty processes for treatment of waste pickle liquor with recovery of by-products. Under simple disposal methods involving no preliminary treatment we have been informed that some companies had tried running the spent pickle liquors into (1) abandoned mines; (2) exhausted oil or gas wells; (3) evaporation ponds; (4) limestone caves, but generally the limestone soon coated over with calcium sulphate and became impervious, the chemical action stopped, the caves filled up and the pickle liquor flowed back into the river.

✦ ✦ ✦

HOWEVER, I was told last evening about one company that is successfully disposing of waste pickle liquor in a limestone formation. This limestone is of a loose, granular, partially disintegrated structure. The system of disposal has been working for four or five years and seems to be taking care of the waste pickle liquor all right.

✦ ✦ ✦

SOME steel companies run the waste pickle liquor; (5) into sumps in sand or porous earth near large bodies of water, where the dilution is sufficient to take care of the acidity of the waste pickle liquor fairly satisfactorily; (6) into deep wells. I have been informed that one of the companies which tried this method of disposal found it worked all right for four or five years before complaints were made by farmers and other people that the water in the wells they used for drinking purposes had gone acid. Investigations showed the geological strata formation was such that, after a long period of time, the acid wastes percolated through and got into the wells.

Fig. 1. Plant for Neutralizing Waste Pickle Liquor with Lime. Courtesy—American Rolling Mills Company. ✦ ✦ ✦

THE courts have decided the highest use for water is for potable and domestic purposes. Therefore, when it comes to interfering with the drinking waters and the domestic uses of water, unless the offender can arrange to replace that water from some other source, the State Sanitary Boards begin to put on the pressure. Hence the steel company had to stop using those wells for disposal of waste pickle liquor.

✦ ✦ ✦

Methods for Disposal of Waste Pickle Liquor Involving a Pre-Treatment, But No Recovery of By-Products

THE second group of disposal methods, as I have classified them after this year's work, includes those in which the waste pickle liquor is given some preliminary treatment and then disposed of with no recovery of by-products.

✦ ✦ ✦

THE simplest of these methods is to neutralize the free acid in the waste pickle liquor with lime or limestone; then pump the resulting suspension into evaporation ponds or reservoirs and depend on surface evaporation and ground seepage to dissipate the water. This method is used at some steel plants.

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ANOTHER method is necessary in certain states where the law requires the company to neutralize the free acid and also to add enough lime to precipitate out the iron; that greatly increases the cost of this method. The resulting suspension or sludge may be disposed of by two different methods: (Figure 1).

ONE is to pump the slurry into settling basins or lagoons. The other is to let the sludge settle, allow the supernatant clear solution to run into the sewers, and then haul the settled sludge to a dump. That method is used in some steel plants. The steel companies are not satisfied with either method, but it is the best they can do at the present time.

Fig. 1A. Basin in Which the Suspended Matter from the Lime Neutralization of Waste Pickle Liquor Is Allowed to Settle. Courtesy—Tennessee Coal, Iron and Railroad Company and Industrial and Engineering Chemistry.

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Another process in this group is the Travers Marl process. It is a limestone process; the marl being a partially disintegrated, decomposed limestone which is said to have especially desirable properties for treating waste pickle liquor. There are some industrial size installations of the Travers Process. The sludge produced may be used to treat sewage or organic wastes.

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THE **Dorr Company** has been working for two years developing a method of disposal which they now have through the pilot plant stage. They add very finely ground limestone to waste pickle liquor, then blow air through it, producing intense agitation. They state that very good results are obtained, and that limestone is cheaper than lime. I understand one company, at least, is considering an installation of the Dorr process. There is no recovery of by-products in this method of disposal. Other methods in this group are neutralization of the waste pickle liquor with scrap iron, iron oxide, or basic slag and pumping or hauling the resulting solutions or slurries to evaporation ponds or dumps, but there are serious objections to these latter methods.

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Processes for Treating Waste Pickle Liquor and Recovering By-Products

NEXT we come to the processes for the treatment of the spent pickle liquor with recovery of by-products, and we have made preliminary studies on about forty processes (1-c). They vary all the way from obtaining copperas ($FeSO_4 \cdot 7H_2O$) which is the most common and oldest method of recovering a by-product from spent pickle liquor, to making sulphuric acid and iron oxide from the liquor.

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SOME of you have seen the article published by **Heinrich** (1-a)# in **Stahl und Eisen** about two years ago. He reviewed a large number of processes and referred to many patents, 14 German, 2 French, 1 Canadian, 19 British and 14 United States patents. In my studies the past year I have found several patents that he did not mention, so there are probably seventy-five to one hundred patents on processes for treatment of waste pickle liquor.

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I THOUGHT you could get a better idea of what they had been trying to do on this problem by showing you a few lantern slides of some of the processes;* then we will briefly discuss a few possible methods of utilization of some of the by-products; and then, as the Chairman said, we will throw the meeting open. He said I would answer your questions. I will do the best I can, but do not know just what the questions will be.

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THE areas of major stream pollution in the United States occur in the states from Minnesota, Iowa and Missouri eastward to the Atlantic Ocean. The pollution is due to the sewage from many cities, acid mine drainage and anthracite culm, industrial wastes from iron and steel mills, oil refineries, food factories, textile mills, packing plants, pulp and paper mills, by-product coke works, chemical plants and many other manufacturing establishments in this highly industrialized section of the country. Farther West we have less stream pollution. However, in California, a few months ago, I found two plants where special arrangement had been made with the health authorities for disposal of waste pickle liquor.

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THE Third Report of the U. S. Government's Special Advisory Committee on Water Pollution classifies our National wastes problem into three divisions. First is the sewage. That is the largest and probably about the worst waste polluting our streams. The Government Committee estimates it would cost $1,000,000,000 to construct sufficient disposal plants to take care of sewage pollution, and it would cost $15,000,000 annually to operate and maintain the plants.

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NEXT come mining wastes; acid drainage and culm from mines; oil field brines, and wastes from hydraulic mining out West. It would cost about $152,000,000 to abate stream pollution from these sources.

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THE third class is industrial wastes occurring during the manufacture of useful organic and inorganic products. The Govern-

 # Refers to references at the end of the discussion.

*** The first part of the discussion was illustrated with lantern slides accompanied by running explanatory comments. The illustrations given in this paper are similar to some of the slides shown.**

ment experts have estimated it would cost $900,000,000 to construct plants and install processes for taking care of these wastes, where processes are known for satisfactorily treating them. It is estimated that costs for maintenance and operation of the plants would be about $225,000,000 annually. They state that for a good many of the wastes there are no known satisfactory processes available.

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THE "ups and downs" of production in the iron and steel industry are shown in Figure 2. The general trend line for steel shows a rapid rise in the United States from 11,838 gross tons in 1860 to 56,433,473 gross tons in 1929. Of course, when the production of iron and steel are up, the quantities of waste materials made are increased and the recovery of by-products becomes more important.

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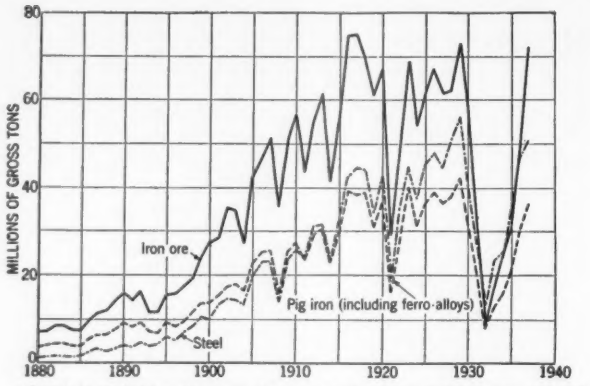
THE data on the manufacture of wire and wire products, and of tin plate and terne plate also show very rapid increases in production over that period of years. People are buying more and more canned products; foods, beer, oils, tobacco, tooth pastes, salves and cosmetics, paints, varnishes and chemicals; also many galvanized materials; wire, fencing, nails, transmission line towers, sheets, tanks, pails, tubs, pipe and tubing. Likewise the markets have grown for metal products which have enameled, varnished, painted, plated, or polished surfaces; such as automobiles, furniture, letter files, desks and office and kitchen equipment. Waste pickle liquor has been increasing in quantity due to the rapidly rising demand for those kinds of iron and steel products which require for their satisfactory manufacture that the surfaces of the metal be thoroughly cleaned by the acid solutions used in the pickling operations.



Trends in production of iron ore, pig iron, and steel in the United States, 1880-1937

Fig. 2. Trends in Production of Iron Ore, Pig Iron and Steel in the United States, 1880-1937. Courtesy—Minerals Year Book, U. S. Bureau of Mines. ✦ ✦ ✦ ✦ ✦ ✦

Fig. 3A. In the Manufacture of Copperas the Free Acid in the Waste Pickle Liquor is Neutralized with Iron Wire Scrap in the Tanks at the Left. The neutralized and Clarified Waste Pickle Liquor is concentrated in the Vertical Evaporators, Center. Courtesy—Wheeling Steel Corporation and The Sulphiro Co. ✦

Fig. 3B. The Crystals of Copperas Having Been Separated from the Mother Liquor by Means of Centrifugals Are Dried in a Rotary Kiln, Bottom left. Recovered Copperas Being Loaded into Box Car By Means of Screw Conveyor, Bottom Right. Courtesy—Wheeling Steel Corporation and The Sulphiro Company. ✦ ✦

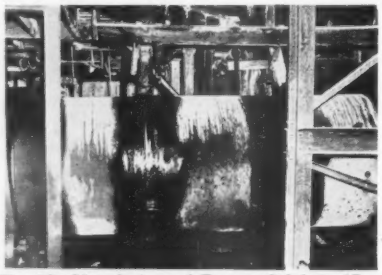


Fig. 3C. Manufacture of Ferrous Sulphate (Copperas) Rotary Drier. Courtesy—Sulphiro Company. ✦ ✦ ✦ ✦

General Process for the Recovery of Copperas, $FeSO_4 . 7H_2O$

SUCCESSIVE operations in one of the older processes for recovering a by-product from waste pickle liquor, namely, copperas, are shown in Figure 3. The waste scrap wire and other scrap iron are put in the tanks so as to neutralize as completely as possible the free acid in the spent pickle liquor. At times the tanks have to be heated so the reaction will go to completion, according to the following general equation: $Fe + H_2SO_4 \longrightarrow 2FeSO_4 + H_2$.

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THE neutralized waste liquor, now a solution of ferrous sulphate is pumped into tanks in which the suspended impurities settle, and from which the clarified liquor goes to the evaporators in which it is concentrated until the iron sulphate begins to crystallize, then it is pumped into the crystallizer. As the liquor cools, the crystals of copperas ($FeSO_4 . 7H_2O$) settle to the bottom of the crystallizer. From there the slurry of crystals is drawn into a centrifugal machine, the the mother liquor is "whizzed" out and the copperas is recovered and is fed to a continuous rotary drier, usually. The photographs from which the accompanying cuts were made were kindly furnished through the courtesy of the **Wheeling Steel Corporation** and the **Sulphiro Company.** Some

Fig. 3D. Manufacture of Ferrous Sulphate (Copperas) Screw Conveyor Distributing Sulphate along the length of the Car, from below. Courtesy —Sulphiro Company. ✦ ✦ ✦

of the copperas is sold as such, some is used in the manufacture of paint pigments and polishing rouge, and for other purposes which we will discuss later. You are all acquainted with this process, but I gave this brief outline of it so that you could the more readily compare it with some of the other processes we wish to discuss.

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THE copperas is the fine crystalline material known in the chemical trade as "Sugar Sulphate of Iron." It is used to some extent in the purification of water, and as chlorinated copperas in sewage disposal plants and as a fungicide and insecticide. There is not nearly a sufficient market for the amount of iron sulphate which could be produced from the waste pickle liquor available.

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I THOUGHT you might be interested in taking a glance at what they are doing on the waste pickle liquor problem in Germany. (The slides shown were made from illustrations given in **Stahl und Eisen** by **Heinrich** (1-a and 1-b) **Agde** (3-a), **Sulfrian** (3-d), **Sierp** and **Fränsemeier** (3-c), **Drooff** (3-b), **Gensecke** (3-f), and **Sierp** (1-d). Apparently the main efforts of the German engineers and inventors have been to develop processes, usually continuous in operation, for the removal from the waste pickle liquor of a portion of its iron sulphate content as copperas, and to return the mother liquor containing the recovered free acid, some iron sulphate and the make-up sulphuric acid to the pickling vats for re-use in cleaning steel.

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AMONG the processes sometimes involving partial evaporation, but depending mainly on cooling for crystallizing copperas from the waste pickle liquor are the **Agde, Drooff** (Figure 4), and **Zahn.** Processes in which a portion of the recovered copperas is dried to ferrous sulphate monohydrate ($FeSO_4 . 1\frac{1}{2}\ H_2O$) and this is added to the incoming spent liquor to aid in crystallizing out more copperas ($FeSO_4 . 7H_2O$) are the **Sierp** and **Fränsemeier** (3-c), and the **Sulfrian** (3-d). Several of the copperas recovery plants have been constructed but the markets for the copperas are limited.

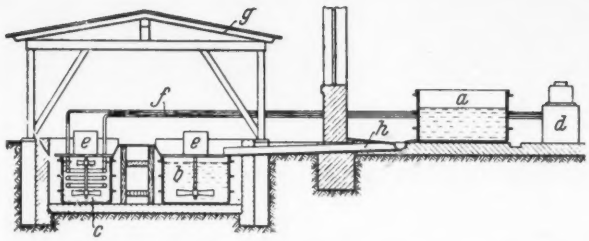

Fig. 4. The Drooff Process; Diagramatic Section of an Installation. a — Picking Vat. b—First Settling Tank. c — Second Settling Tank. d—Linde "automit" Refrigeration Equipment. e—Motors which Drive the Stirrers. f—Cooling Brine Pipe. g—Protective Roof, Open Construction. h—Trough for Acid. Courtesy—Stahl und Eisen. The spent pickle liquor is run from pickling vat (a) into first settling tank (b). As the spent liquor cools, crystals of copperas form. When crystallization is completed the mother liquor is pumped into the second settling tank (c) and sufficient concentrated sulphuric acid is added to bring the content of the mother liquor to about 28% H_2SO_4. In this tank the solution is cooled to about 0°C. by means of circulating cold brine from the Linde refrigerating equipment (d) through the coils of lead pipe installed in the tank. A second crop of copperas is obtained. The mother liquor from this second crystallization is pumped back to pickling bath (a), diluted with water to a concentration of 18% H_2SO_4 and is again used for cleaning more steel. Due to the stirring operations during cooling of the waste pickle liquor, the copperas formed is finely crystalline and is easily shoveled from tanks (b) and (c). This batch process for treating waste pickle liquor is reported to be giving satisfactory results. ✦

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THEY are also developing in Germany a number of processes for manufacturing ammonium compounds from waste pickle liquor by treating it with ammonia or with coke oven gas, thereby obtaining ammonium sulphate, $(NH_4)_2SO_4$, and iron hydroide, carbonate or sulphide. **Sierp** (1-d) describes a few of these processes: the **Bochmann, Hilgenstock** and **Jung,** and of the **Ruhr Verband** (Association of Iron and Steel Manufacturers of the Ruhr District, Germany).

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IN the United States there has also been considerable research on processes for making ammonium sulphate from spent pickling liquors, as evidenced by patents issued to: **Falding** and **Cathcart** in 1910; **Harris** in 1935; **Davies** in 1934, and to **Sperr** (assigned to the Koppers Company) in 1930, 34, and 35. The utilization of two waste materials, the alkaline ammoniacal liquors from the by-product coke works to neutralize the acid spent pickle liquor from the steel mills, to produce two useful products, ammonium sulphate for fertilizer, and iron oxide for charging back into the blast furnace, would appear to be a natural and economical procedure for disposing of the wastes. The tendency of impurities such as sulphides, chlorides, cyanates and cyanides to be present in the ammonium sulphate and the difficulties in filtration of the colloidal iron hydroxide precipitate formed as shown in equation A are among the factors which have probably retarded the more general installation of ammonia processes for treating spent pickle liquor. Reports of recent researches indicate that these process difficulties are being overcome and for steel companies which have the waste pickle liquors and by-product coke plant ammonia liquors and gas available in nearby areas this type of process appears to be worthy of serious investigation as a possible method for disposal of the waste pickle liquor.

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Equation A

$$4NH_4OH + FeSO_4 + H_2SO_4 + nH_2O \longrightarrow Fe(OH)_2 + 2(NH_4)_2SO_4 + (n+2)H_2O$$

Ammonium hydroxide — **(Waste pickle liquor)** — **Ferrous (iron) hydroxide** — **Ammonium Sulphate**

$$4Fe(OH)_2 + O_2 \xrightarrow[\text{in air}]{\text{heating}} 2\ Fe_2O_3 + 4H_2O$$

Ferrous (iron) hydroxide — **Oxygen** — **Ferric (iron) oxide** — **Water**

AT Isberques, France in 1933 the **Compagniedes Forges et Chatillon** installed a **Lurgi** process plant for treating the waste pickle liquors. This is another modern application of the principles developed by Charpy. As shown in Figure 5, a steam multijet vacuum evaporator is used to concentrate the waste pickle liquor and cool it so that copperas crystallizes. The suspension is pumped into a cone bottom tank where the copperas settles and is drawn with a small quantity of the mother liquor into a centrifugal which separates the copperas and air dries it. The clear supernatant mother liquor from the settling tank, also that separated in the centrifugal, both containing free acid and some of the iron sulphate from the waste pickle liquor, are pumped back to the pickling vats and re-used with the correct quantities of make-up sulphuric acid and water in pickling more iron and steel. Gensecke (3-f) states that this copperas recovery plant has for several years been operating very satisfactorily and a similar plant has been recently installed in Germany. Waste steam can be used to run the evaporator and costs for power and maintenance are stated to be very low. This appears to be one of the simpler and perhaps more efficient processes in operation in Europe, but if all the steel companies installed this process the question would arise as to how to dispose of the recovered copperas.

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IN the United States, also, processes quite similar to the **Agde** and **Zahn** have been developed to remove a portion of the iron sulphate from the waste pickle liquor and recirculate the mother liquor containing some iron sulphate and the free acid from the spent liquor back to the pickling tanks. U. S. patents for such a process were issued to **Marsh** and **Cochran** in 1921-'23 and '26 and an industrial installation of the process is reported to have been made. During the past five years the **Butler-Little** Reclamation Process has been developed and the first industrial size installation has been constructed by the **American Rolling Mill Company.** This process is also designed for continuous operation, separating a portion of the iron sulphate from the waste pickle liquor and returning the mother liquor to the picklers. A **Butler-Little** process plant is illustrated in Figure 6. The spent liquor is sprayed into the top of a tall lead lined tower and air blown in at the bottom of the tower passes upward, counter-current to the descending spray of waste liquor. This causes some evaporation of the water in the waste pickle liquor and cools the drops of spray to such an extent that copperas crystallizes and is collected in the cone bottom tank constructed under the "reclaim" tower. The copperas settles to the bottom of the tank from which the slurry is pumped to a centrifuge that separates the crystals from the mother liquor. The copperas is removed from the centrifuge and sold or stored and the recovered acidic mother liquors are recirculated to the picklers. Certain difficulties have arisen in the operation of the reclaim tower during the hot summer months and further developments on the process are contemplated.

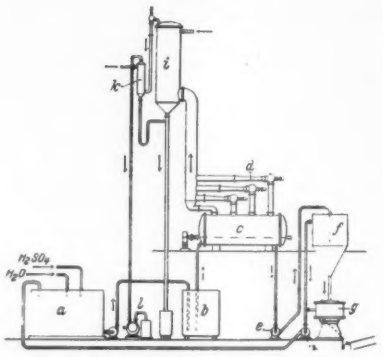

Fig. 5. Process of the Compagnie des Forges de Chatillon (Lugri System) Diagramatic Drawing. a—Pickling Vats. b—Storage and Settling Tanks. c—Crystallizer. d—Steam jets for Producing Vacuum. e—Slurry Pump. f—Equalizing, Cooling and Settling Tank. g—Centrifugal Separator. h—Pump for Returning Acid Mother Liquor to Pickling vat. i and k—condensers. l—Pump for Removal of Air from Condensers. Courtesy—Stahl und Eisen. ✦ ✦ ✦

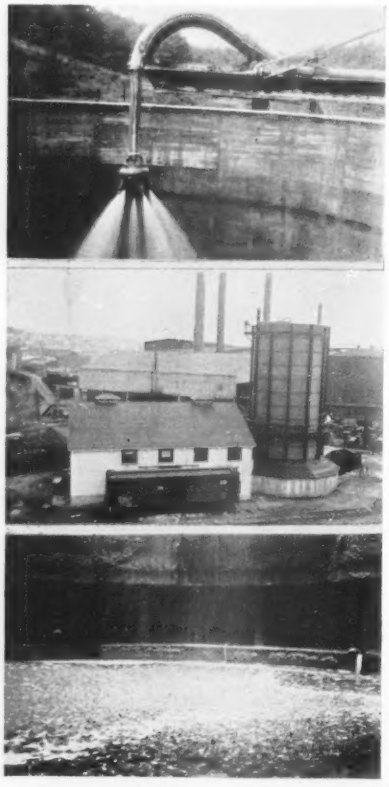

Fig. 6. The Butler-Little Reclamation Process. 1—Spraying Waste Pickle Liquor into top Tower. 2—Reclaim Tower and Building for Centrifugal Separators and Storage of Recovered Copperas. 3—Collecting tanks in Base of Tower. Courtesy—American Rolling Mill Company. ✦

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THE **Simonson-Mantius** process has also been developed in this country and is applied to separate copperas from the waste pickle liquor with or without going to the trouble and expense of neutralizing the spent liquor. The waste liquors are concentrated in steam heated, lead lined vacuum evaporators until a portion of the copperas crystallizes and on cooling the liquor, more copperas is formed. It is separated in a centrifuge or filter from the acidic mother liquor which is returned to the picklers for re-use. I need not discuss this process in detail since many of you heard the excellent paper on this process presented by **Dr. Otto Mantius** at the Acid Disposal Symposium held under the auspices of the Wire Association at the Annual Convention in Detroit, Michigan last year. The paper was published in the October, 1938 number of **Wire and Wire Products** (2-c).

TWO of the factors which have mitigated against the installation of the type of processes which recover copperas and the free acid from the waste pickle liquor are: (1) the lack of anything like sufficient markets for the copperas; and (2) objections of the operators to using the recovered acidic mother liquor in the pickling operation, because of the accumulation of impurities which are said to often produce difficultly removable stains on the sheets or wire in the picklers. However, it is reported that two steel plants in this country and some fifteen to twenty plants in Europe are using recovered acid in their pickling operations.

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THE twenty copperas factories in operation in the United States in 1937 produced 43,916 tons of the copperas ($FeSO_4 . 7H_2O$) which was somewhat more than the market demanded that year. During 1938, when iron and steel production was low, there was a shortage of copperas reported in some sections of the country. Estimates which we have received indicate that there are from 500,000,000 to 800,000,000 gallons of waste pickle liquor made in the United States annually. If we assume 700,000,000 gallons per year having an average composition of 3 per cent free acid and 15 per cent ferrous sulphate, the spent liquors would contain total quantities of approximately 105,000 tons of concentrated sulphuric acid, (H_2SO_4) and 961,000 tons of copperas. Certain other industries, such as the titanium pigment plants could also readily manufacture large amounts of copperas. Apparently there is no object in manufacturing more copperas unless new uses for it can be discovered, or the present markets be enlarged.

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IN comparatively recent years many researches have been made toward developing processes to recover ferrous sulphate monohydrate, $FeSO_4 . 1\frac{1}{2} H_2O$ (approximately) and the free sulphuric acid directly from the waste pickle liquor. In this group of processes are the **Mantius, Whetzel** and **Zimmerman,** and possibly that of the **Western Precipitation Corporation.** There are three large installations of the Mantius process (Figure 7). The plant I inspected at **Curtis Bay, Md.** was operating on waste leach liquor containing around 19% to 22% free sulphuric acid, 10% to 12% ferrous sulphate and very small quantities of some other salts. The suspended impurities in the waste leach liquor are allowed to settle out in a lead-lined storage tank and the clarified liquor is concentrated, in three steam heated, lead-lined vacuum evaporators operated in series, until the concentration of acid reaches about 65% H_2SO_4 in the third effect. The ferrous sulphate monohydrate may be separated from the acidic mother liquor by use of a centrifuge or filter and the filtrate or the suspension may be transferred to the fourth evaporator which is called the super-concentrator. It operates on the batch system and concentrates the liquor from 65% to about 78% H_2SO_4. The ferrous sulphate monohydrate is separated in continuous horizontal centrifuges from the concentrated recovered sulphuric acid which is sold or reused. This plant is reported to have been in continuous and satisfactory operation for about two years.

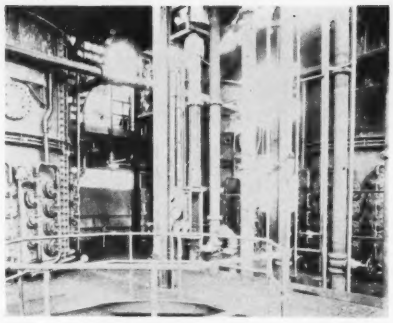

Fig. 7. The Mantius Process. One of Three Installations of Recovery of Sulphuric Acid and Ferrous Sulphate from Waste Liquors. Courtesy—National Lead Company and E. I. duPont de Nemours and Company. ✦ ✦

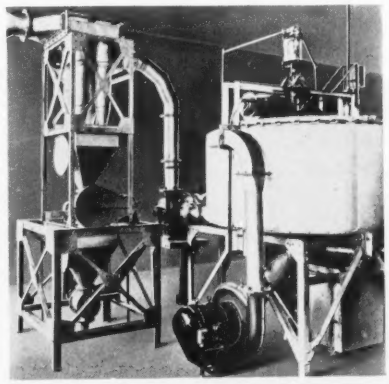

Fig. 8. Pilot plant for Spray Drying Waste Pickle Liquor. Courtesy—Western Precipitation Corp. ✦ ✦ ✦ ✦

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IN 1935, U. S. Patent No. 2,005,120 was issued to **J. C. Whetzel** and **R. E. Zimmerman** (it was assigned to **American Sheet and Tinplate Company**) for a new type process to precipitate ferrous sulphate monohydrate from waste pickle liquor and recover the free sulphuric acid. The spent liquor is run into an autoclave, the valves are then closed and live steam, usually at 300° to 400°F. is injected into the autoclave. Under these conditions of temperature and pressure the ferrous sulphate monohydrate is thrown out of the solution. The resulting suspension is passed from the bottom of the autoclave into a direct connected filter which operates under similar conditions of temperature and pressure to separate the monohydrate from the acidic mother liquor. The recovered acid would be reused in the pickling vats and the ferrous sulphate monohydrate sold or used in the manufacture of sulphuric acid. This process has passed through the laboratory stage of development, but there is no industrial installation of it to date.

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IN Los Angeles, Calif., about three months ago at the Research Laboratories of the **Western Precipitation Corporation** I observed a successful pilot plant (Figure 8) demonstration of the direct spray drying of waste pickle liquor producing a light grey powder, fine but not excessively dust, and free flowing. The powder was distinctly acid to litmus paper, while the stack gases were not very acid and no fumes or dust were observed coming from the stack

during that demonstration. The engineers in charge of this development stated that they had made several successful runs spray drying neutralized spent pickle liquor and were now endeavoring to develop the process and equipment so that the unneutralized liquor could be satisfactorily spray dried to recover ferrous sulphate monohydrate and most of the free acid. In this latter method it might sometimes be necessary to pass the exit gases from the dryer through a lime-water scrubbing tower to eliminate all possibilities of any atmospheric pollution.

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AMONG the advantages claimed for ferrous sulphate monohydrate ($FeSO_4 \cdot 1\frac{1}{2}\ H_2O$) as compared with copperas ($FeSO_4 \cdot 7H_2O$) are: (1) good storage properties; (2) much lower content of water of crystallization, which means (3) lower costs for shipment per ton of available $FeSO_4$; (4) is free flowing, with little tendency to cake, hence could probably be used in dry feed machines; and (5) it is the preferred compound if the iron sulphate is to be used in the manufacture of sulphuric acid. Objections which have been raised against this type of process are: (1) the expensive corrosion resistant equipment which must be installed since the materials are processed in an acid condition; (2) costs for steam or fuel; (3) difficulties in the filtration of the monohydrate; and (4) objections of the operators to using recovered acid in the pickling operation. However, recent development in the manufacture of acid resistant materials of construction and in filters have improved the possibilities for many of the waste pickle liquor treating processes, and the recovered sulphuric acid might be used for other purposes if it was not pure enough for reuse in the pickler. The selling of the ferrous sulphate monohydrate is a problem since there are few markets for it at present. It could be used in the manufacture of sulphuric acid, but that involves a large additional capital investment for a sulphuric acid plant, hence might necessitate a cooperative enterprise by all the steel plants having waste pickle liquor in a given district.

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Fig. 9A. Plant under Construction in 1935. ✦

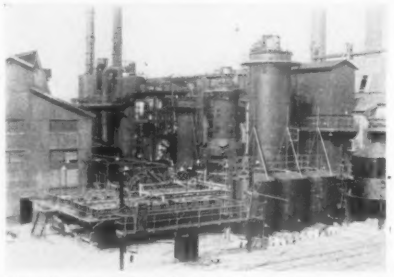

Fig. 9B. Completed Plant in Operation. ✦

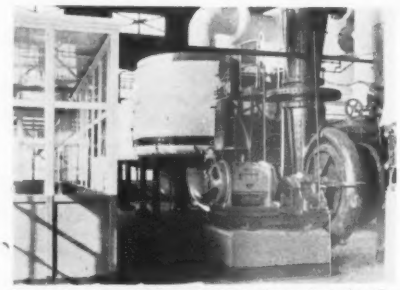

Fig. 9C. One of the Contact Converters in the Sulphuric Acid Dept. Courtesy — Chemical Construction Corp. and Titanium Pigment Co. ✦

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Utilization of Waste Pickle Liquor In the Manufacture of Sulphuric Acid and Iron Oxide

THE manufacture of sulphuric acid and iron oxide from waste pickle liquor has been the objective of many researches and investigations, especially within the last decade. Some of the processes in this group are the **"Chemico" Sulphate Conversion; Mantius-Leonard-Monsanto; Clarkson or Fersul;** and the **I. G. Farbenindustrie** process. There are several other proposed processes in this class, but the four mentioned have each progressed through pilot plant development; also it is reported that there are industrial installations of two of them in operation. Any of the processes which make copperas or ferrous sulphate monohydrate from waste pickle liquor might be applied as the first steps in a process to manufacture sulphuric acid and iron oxide therefrom. Extended investigations in Germany and the United States have shown that the copperas ($FeSO_4 \cdot 7H_2O$) should be dried to either the ferrous sulphate trihydrate ($FeSO_4 \cdot 3H_2O$), or the monohydrate ($FeSO_4 \cdot 1\frac{1}{2}\ H_2O$) before it is fed to the roasting furnace in which the iron sulphate is broken down into iron oxide, sulphur dioxide and usually small amounts of sulphur trioxide.

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WE do not have time this morning to outline the unit operations in all of the processes in any of the different classes. In this sulphuric acid + iron oxide class I might review a few of the points which **Mr. S. F. Spangler** of the **Chemical Construction Corporation** (2-a) gave in the very good paper which he presented at the Acid Disposal Symposium held by the **Wire Association** during its convention in Detroit last year. The first installation of the **"Chemico"** Sulphate Conversion process was in St. Louis, Mo., in 1934 by the **Titanium Pigment Company.** This company constructed a much larger **"Chemico"** plant at their Sayreville, N. J., pigment factory in 1935, (Figure 9). The more important unit operations in this process are as follows: The waste leach liquor containing from 18% to 25% free sulphuric acid, from 10% to 16% ferrous sulphate, and traces of titanium sulphate and other salts is neutralized with iron oxide and the neutralized liquor is directly evaporated and dried in large continuous rotary dehydrators to form ferrous sulphate monohydrate. This material is mixed with the correct proportions of iron pyrites and the mixture is roasted to produce iron oxide and sulphur dioxide. The exit gases from the roasting furnace are carefully purified by passing them

through settling chambers, scrubbing towers and Cottrell precipitators and the purified sulphur dioxide is manufactured into pure concentrated sulphuric acid in a vanadium contact plant. A portion of the iron oxide is returned to the process to neutralize the incoming waste leach liquor. The other portion of the iron oxide, by improvements in the process reported during the past year, is sintered into a cinder suitable for charging into the blast furnace. It is stated that this plant has been in practically continuous operation since its construction and after overcoming certain initial difficulties has been giving very satisfactory results.

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SOME of the objections brought against this class of processes are: high initial costs for construction and installation of equipment; rather high maintenance charges; the necessity for continuous operation; and for large scale production, if the over-all costs for making the sulphuric acid are to be kept reasonably low. This class of processes has marked advantages in that there are usually good markets for the sulphuric acid and iron oxide and if installed at or near the steel works the costs for transportation of two of their much used materials may be greatly reduced.

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Manufacture of Building Materials From Waste Pickle Liquor; The "Ferron" Process

THE problem of utilizing the sludge formed when waste pickle liquor is neutralized with lime has, during the past four years, been intensively investigated by **Dr. M. J. Rentschler,** Director of Research (2-b), and **H. S. Colton,** Chemical Engineer of the **Allied Development Corporation** and they have developed the **"Ferron"** process. **Mr. H. W. Lynn** of the **Wean Engineering Company** described this process at the Wire Association's Symposium on Acid Disposal in Detroit last year, hence I will not discuss it in detail. The process involves neutralization of the waste pickle liquor with lime under carefully controlled conditions. The main chemical reactions taking place may be represented by the equation B.

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THE suspension of iron hydroxide + calcium sulphate is pumped into a filter which separates the precipitate from the suspension and the clear, neutral filtrate is run into the sewer. The filter cake of greenish colored, plastic ferrous hydroxide and calcium sulphate (gypsum) is thoroughly mixed in a pug mill, any desired filler such as shredded paper, asbestos fiber, or clay being added and evenly incorporated in the plastic mass which is then extruded in the form of long bars, blocks or other shapes. This "green Ferron" is dried in a gas fired tunnel dryer and changes, probably through oxidation in air to ferric compounds, to a reddish brown, non-plastic material which can be sawed and machined into building blocks, bricks, wall board or other desired products. So far as I know, this is the first process to be developed for making usable products from the precipitate formed when waste pickle liquor is neutralized with lime, (Figure 10).

Equation B

$$Ca(OH)_2 + FeSO_4 + H_2SO_4 + nH_2O \longrightarrow Fe(OH)_2 + CaSO_4 \cdot 2H_2O + (n-2)H_2O$$

Calcium hydroxide	Waste pickle liquor	Ferrous (iron) hydroxide	Calcium Sulphate	Water

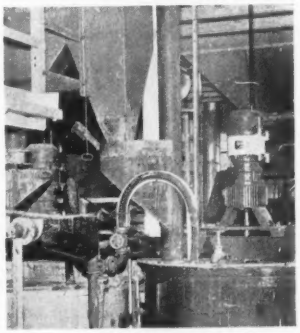

Fig. 10A. In the Ferron Process, Milk of Lime is Mixed with Waste Pickle Liquor and Agitated Until Acid is Neutralized and Iron is Precipitated in the Neutralization Tank Shown Above. Courtesy—Sharon Steel Corporation, Allied Development Corporation and Iron and Steel Engineer.

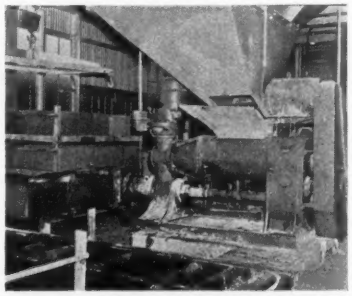

Fig. 10B. The Iron Hydroxide-Calcium Sulphate Sludge from the Neutralization Tank is Filter Pressed. Press Cakes Are Dropped Into the Pug Mill Shown Above Where They Are Made into A Uniform Mass and Extruded in Block Form. Courtesy — Sharon Steel Corporation, Allied Development Corporation and Iron and Steel Engineer.

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ABOUT one year ago the **Sharon Steel Corporation** constructed a Ferron process plant to treat the spent pickle liquor at one of their steel works. The clear, neutral filtrate from the filter has been tentatively approved by the Pennsylvania Sanitary Water Board as satisfactory for discharging into streams. Two of the problems in this process are (1) the filtration of the colloidal or jelly-like iron hydroxide precipitate; and (2) marketing the Ferron. During the past summer decided improvements have been reported in carrying through certain of the unit operations; neutralization of the liquor, and in filtration of suspension; also a method has been developed for making a very much improved type of Ferron wall board. Some of the large dealers in building materials are said to be interested in the possibilities of marketing the Ferron products.

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Waste Pickle Liquor in the Manufacture of Polishing Rouge and Paint Pigments

FOR a great many years it has been common practice to roast

copperas obtainable from waste pickle liquor, and produce very minute size particles of iron oxide which possess especially good properties for glass polishing, or as pigments in paints. A number of processes have been patented and some of them developed industrially for using waste pickle liquor as the raw material for the manufacture of the polishing rouge and paint pigments. Among this class of processes are: the **Parker, Kestner - Neill, Clarkson, Stich, Wespy-Padberg, Society for Chemical and Metallurgical Production in Aussig, Fireman,** and others. We have time to outline only one of these processes and have taken the **Kestner - Neill** in which the waste pickle liquor is evaporated and dried in a Kestner spray dryer to produce ferrous sulphate monohydrate. In the original **Kestner-Neill** process the monohydrate was fed into a continuous rotary roasting furnace which drove off the remaining water of hydration and the oxides of sulphur and produced grades of iron oxides especially suitable for use as paint pigments. Perhaps the largest present development of this process is that of **Pilkington Brothers, Ltd.,** glass manufacturers in England. They roast the ferrous sulphate monohydrate in a specially designed muffle furnace to manufacture a fine grade of glass polishing rouge. The manager of their Research Department informed me that it was the best polishing rouge they had ever used. He also kindly sent me the photographs from which the accompanying illustrations of the plant and process were made (Figure 11). While the manufacture of iron oxide paint pigments and polishing rouge consumes some waste pickle liquor the markets for these products is rather limited, amounting in the United States to a total of about 59,000 tons in 1935 and that figure includes a large amount of natural oxides. However, there may be certain localities where a steel company could utilize their spent pickle liquors for making pigments or polishing rouge, or as in certain cases reported on, where the steel company disposes of the waste pickle liquor to a local chemical company which manufactures the polishing rouge or paint pigments.

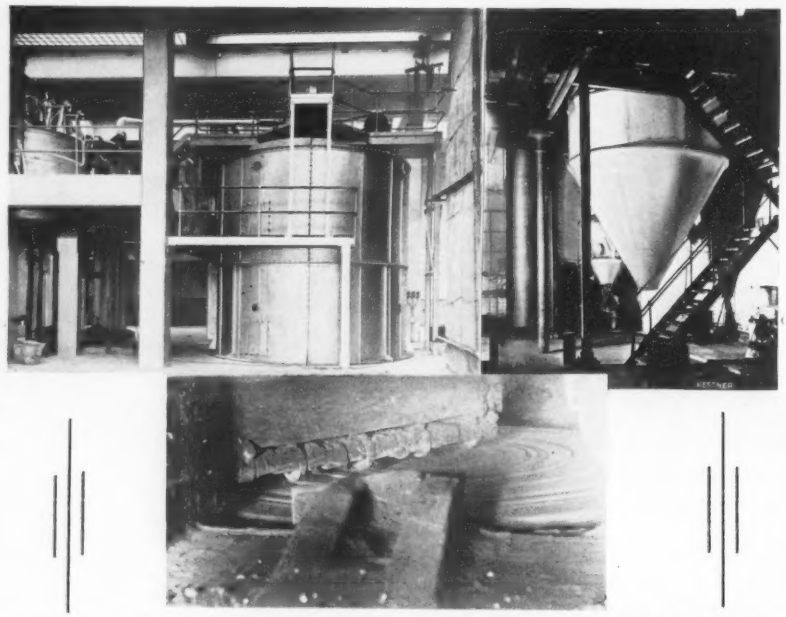

Fig. 11. In the Kestner-Neill Process the Waste Pickle Liquor is Spray Dried in the Kestner Patent Spray Drier Shown at the Top Together with its Auxiliary Feed Tank and Feed Pump. The Powder is Discharged at the Drying-Chamber Base Shown at Center. The Powder is then Roasted in the Calcining Furnace to Produce Rouge. At the Bottom is a View of the Calcining Furnace Through the Inspection Door showing Ridges of Rouge on Turntable and Rabble Supporting Bar. Courtesy—Kestner Evaporator & Engineering Co., Ltd., Pilkton Bros. Ltd. and Industrial and Engineering Chemistry.

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THERE are many other processes for the treatment of spent pickling liquors; those of **Keyes,** and of **Lyles** for making from the liquor, ferric sulphate for use in the purification of water supplies and treatment of sewage; electrolytic processes such as those of **Farnham, Ramage, Gaver** and others, in which electrolytic iron may be produced and the sulphuric acid regenerated; and processes for making various inorganic compounds; such as sodium sulphate, natrojarosite, iron phosphate from the spent pickling liquor. Many of the processes are outlined in papers published within the past three years by **Heinrich** (1-a and 1-b), **Sierp** (1-d), your speaker (1-c), and others. Many of the processes we have mentioned are all right chemically and from the engineering standpoint, but the economic factors such as costs for construction, operation, or the marketing of the by-products obtained are not favorable for their installations. So far as our studies have progressed to date, on the **American Iron and Steel Institute's Fellowship at Mellon Institute,** it does not appear that any one particular process for treating the waste pickle liquor would be best for all the steel plants. Many factors have to be considered, quantity of spent liquor produced; the percentages of free acid and of iron sulphate in the liquor, state and local laws regarding atmospheric and stream pollution; possible markets within reasonable shipping distance for the by-products recovered, as well as costs for constructing and operating the plant for treating the waste pickle liquor.

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Possible Uses of Waste Pickle Liquor and of Recoverable By-Products

FROM our investigation to date of the waste pickle liquor problem and from discussions with many officials, engineers and chemists in the iron and steel companies, it is apparent that unless the spent liquor is processed to sulphuric acid and iron oxide, or to

ammonium sulphate and iron oxide, the profitable marketing of the by-products obtained is a serious problem for the other processes studied. The possible uses for waste pickle liquor as a raw material for building construction materials is being thoroughly investigated by the companies interested in the development of the Ferron process. The utilization of the spent liquor for the manufacture of paint pigments and polishing rouge might perhaps be increased to some extent, but as previously stated, the total markets available are not large, being only about 60,000 tons per year including many iron containing pigments such as Prussian Blue, in which the percentage of iron is relatively small and contain no iron oxide as such. Also the mixed acid waste pickle liquors and those containing certain inhibitors are said to be unsuitable for pigment manufacture. The **American Steel and Wire Company** and certain other steel companies have done a great deal of good research and development work on the uses of copperas, obtained from the spent liquors, as a weedicide, fungicide and for sprays on crops and orchards, but again the markets are limited. The total copperas consumed in all Germany for agricultural purposes is given as only about 7,000 tons per year and the steel manufacturers of the Ruhr and other districts have been working on the proposition for many years.

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IN conferences last summer with officials of some of the iron and steel plants in California and Colorado, I told them about the use made of iron salts added to fertilizers applied to the soils of vineyards in certain parts of Europe. The presence of the soluble iron salts in the soil is said to help increase the yield of grapes, give the fruit a better color, which is also imparted to the wine made from the grapes. Soluble iron salts are also added to fertilizers applied to fields growing pineapples. One steel plant official told me that his company had considered installing a copperas factory and shipping the copperas to the Hawaiian Islands for use in the pineapple industry, but they found the costs of transportation were so high that the proposition was dropped. However, if a good cheap process could be developed for the manufacture of ferrous sulphate monohydrate ($FeSO_4 \cdot 1\frac{1}{2} H_2O$) the shipping costs on this material would be much less per ton of available ferrous sulphate, ($FeSO_4$) then on the copperas ($FeSO_4 \cdot 7H_2O$), which contains 7 mols water of crystallization per 1 mol of iron sulphate. Stated otherwise, when shipping copperas you are paying freight on a compound that is 45.36% water, hence long distance shipments of copperas, under existing freight rates for such chemicals often makes the cost of the copperas to the consumer too high, even though from the technical standpoint the copperas could well be used for the purpose desired.

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SOME other markets which consume small quantities of iron salts are: as mordants for dyes in the textile plants, in tanning leather, as a wood preservative and in pharmaceutical preparations and medicinals, but there does not appear to be much opportunity of increasing the limited demands for iron compounds in these lines.

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THERE are three fields of usefulness for waste pickle liquor and iron salts obtainable therefrom in which, judging from our studies at Mellon Institute and information obtained in my travels and interviews, there appears to be an upward trend in consumption. These are for use in purification of water supplies, in the treatment of sewage, and possibly in treating certain organic industrial wastes. Last spring I had the pleasure of an inspection to the Akron, O., water purification works at Kent, Ohio, and Mr. J. S. Gettrust, Superintendent of Filtration, showed me through the plant and explained how they utilize the waste liquor as a coagulant in the purification of the city water supply (Figure 12).

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THE waste pickle liquor is hauled from the steel works, in an iron tank mounted on a truck, to the water purification plant. Here the liquor flows by gravity into a wooden storage tank. This tank has been in use for more than three years and appeared to still be in good condition. The waste pickle liquor is chlorinated and flows through orifice valves and is mixed with the raw water—sometimes they add a little lime and sometimes a little alum. They test the water before treatment, of course, and regulate the feed of those chemicals so as to get a satisfactory "floc" and good purified water.

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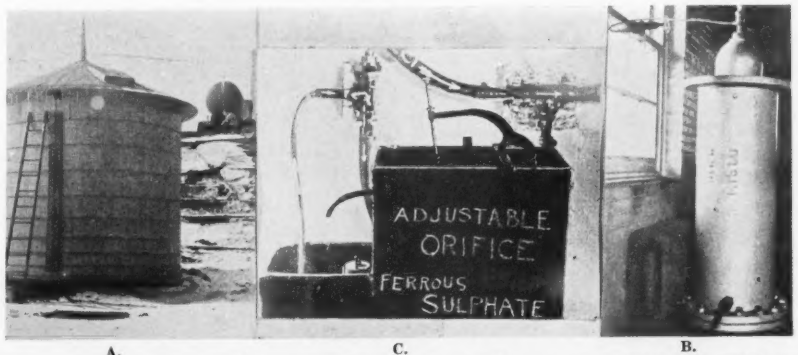
THEY sometimes apply chlorinated copperas solutions when they cannot get enough waste pickle liquor. That is the



A. C. B.

Fig. 12. Use of Waste Pickle Liquor in the Purification of Water. A. Tank Truck with Which the Waste Pickle Is Hauled from the Steel Mills and Wooden Tank in Which the Liquor is Stored. B. Chlorine Vaporizer Used in Chlorinating the Spent Pickle Liquor. C. Orifice Tank and Equipment Used to Feed the Chlorinated Pickle Liquor into the Raw Water Being Purified. Courtesy—Mr. J. B. Gettrust and Water Works Engineering.

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only case I have found where they use waste pickle liquor itself in the purification of a water supply. It was stated that when they have enough pickle liquor they save over 50% of what is used to cost for the chemical purification of the water by the method formerly employed.

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TWO other possible uses for chlorinated waste pickle liquor, copperas and ferric sulphate, which can be made from pickle liquor, are in the treatment of sewage and certain organic industrial wastes.

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WHILE in Birmingham, Ala. last year I made an inspection trip to the **Shades Valley** sewage disposal plant, which was constructed somewhat as an experimental plant to try the use of chlorinated copperas in the treatment of sewage. Results were reported to be very satisfactory. If you have visited sewage disposal plants in the hot summertime, you may have noticed bad odors, flies and bugs around them especially in the old trickling or percolating filter type of plant. With the system in use at Shades Valley you think you are coming into a city park instead of a sewage disposal plant.

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THE copperas is chlorinated and used, especially during the summer season, to give the sewage a preliminary purification treatment. They also have some digestion tanks in the system to complete the sewage treatment and be sure of a non-putrescible effluent. This plant has been giving good results since its construction in 1933. A flow sheet of the plant given in a paper by **Hendon** (4-b) is shown in Figure 13.*

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APPARENTLY this sewage treatment plant is making good use of a product which formerly polluted the streams in the Birmingham District. While we were going through the plant, the Superintendent ordered fifty tons of copperas from the wire mills for use in the sewage plant during the summer.

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THIS brief outline gives you a "bird's eye view" of some of the waste pickle liquor treatment processes we have studied and some possible uses for the liquor and the by-products obtainable from it.

*** The operation of the Shades Valley Sewage Disposal Plant, the Akron Water Purification Works; also several of the processes for the treatment of waste pickle liquors, were explained by Mr. Hodge and illustrated with lantern slides. Cuts for many of these are not available.**

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(c) Hodge, W. W., Industrial and Engineering Chemistry, 31, pp. 1364-80, (1939).

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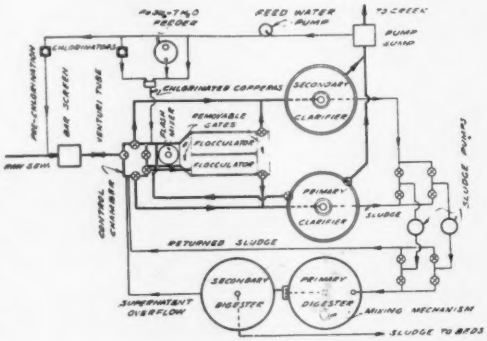

FIG.
Flow Sheet
Shades Valley Plant, Birmingham, Ala.

Fig. 13. Flow Sheet Showing Use of Chlorinated Copperas in Sewage Treatment. Courtesy—Transactions of Institution of Chemical Engineers. London.

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2. Some Recent American Processes in Industrial Development

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Spangler, S. F., and Tillestad, N., Wire and Wire Products, 13, No. 10, pp. 591-4 (1938).

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(c) The Simonson-Mantius Process

Mantius, Otto, Wire and Wire Products, Vol. 13, No. 10, pp. 585-9 (1938).

(d) The Dorr Process

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3. Some Foreign Processes in Industrial Development

German Processes

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(d) Sulfrian, A., Stahl und Eisen, 57, pp. 813-815 (1937).

British and French Processes

(e) Reavell, J. A., Journal Society of Chemical Industry, 47, pp. 347-51T (1928).

(f) Gensecke, W., Stahl und Eisen, 57, pp. 841-2, (1937).

For many of the American and Foreign processes, about the only published information available is that given in the patents. Many of the patents are referred to in the references given in Group 1.

4. General Papers on Use of Copperas and Other Iron Salts in Sewage Treatment and Industrial Wastes

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(a) Gettrust, J. S. and Hostettler, C. O., Water Works Engineering, 92, pp. 245-8 (1939).

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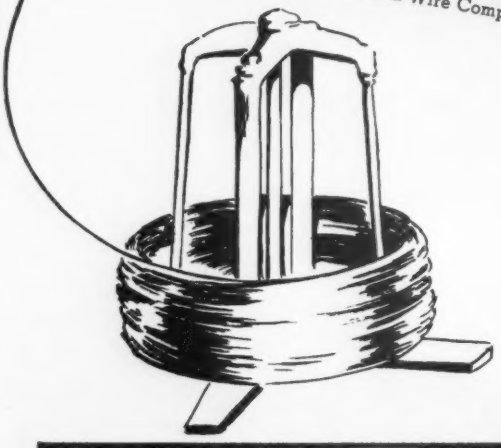

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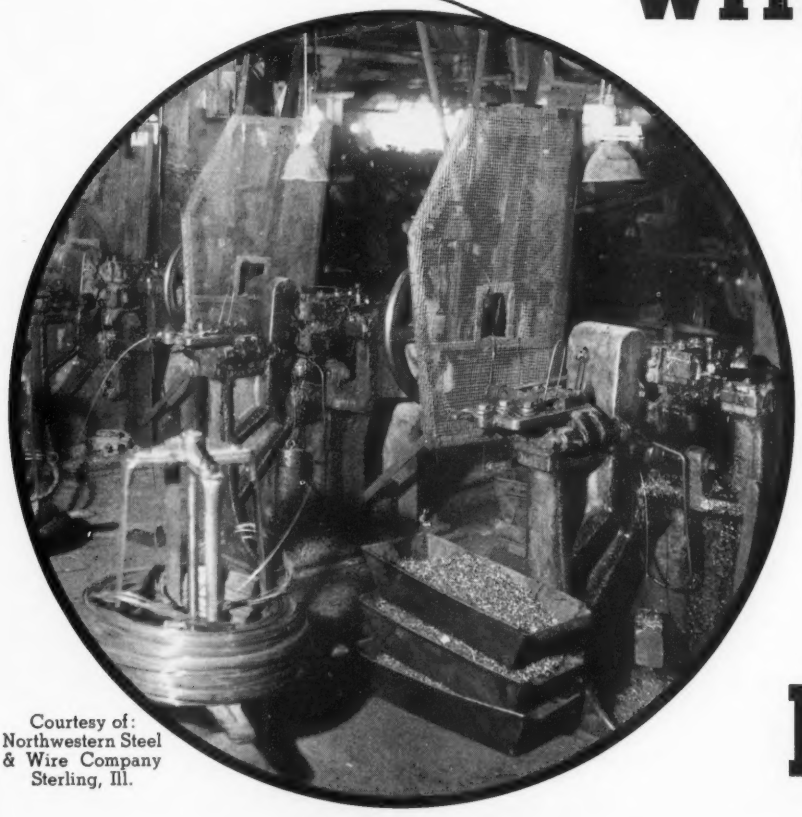

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PROCEEDINGS

The Wire Association 1939 Meeting

CHICAGO, ILL., OCTOBER — 23 - 24 - 25 - 26, 1939

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The Attendance List for the Identification of Speakers Will Be Found on Page 66.

The President's Address by F. A. Westphal will be Found on Page 641 of the November, 1939 Wire & Wire Products.

"Wire in War," an Address Delivered by Major General Joseph O. Mauborgne, Chief Signal Officer, U. S. Army, at The Wire Association Convention Luncheon, will be found on Page 637 of the November, 1939 issue.

FERROUS DIVISION

Meeting, Monday, October 23, 1939 - 2:30 P. M.

Chairman of Meeting

E. W. GUNDSTROM, Plant Manager,
Rome Cable Corp., Rome, N. Y.

PAPER: "CHARACTERISTICS OF MILD STEEL WELDING WIRE"

By J. C. JOUBLANC, Technical Director, Electrode Division,
Harnischfeger Corporation, Milwaukee, Wisconsin

(Paper Published in December, 1939 issue of Wire & Wire Products - Page 697)

The 1939 Annual Convention of The Wire Association was called to order at the Congress Hotel, Chicago, Illinois, Monday, October 23rd, at 2:33 o'clock, Mr. E. W. Gundstrom, Plant Manager, Rome Cable Corp., Rome, N. Y., presiding.

Chairman Gundstrom: Will the meeting please come to order.

The first speaker for this meeting is Mr. J. C. Joublanc, Technical Director, Electrode Division, Harnischfeger Corporation, Milwaukee, Wisconsin, who will speak on "Characteristics of Mild Steel Welding Wire." Mr. Joublanc.

. . . Mr. Joublanc abstracted his paper . . .

Chairman Gundstrom: Thank you, Mr. Joublanc.

Is there any discussion?

Mr. Westphal: Mr. Chairman, I think on behalf of The Wire Association we should congratulate Major Joublanc on his paper and the discussion he has given us with it, which thoroughly shows a very high quality of technical and professional information on top of a lot of original research on his part.

I would like to ask Major Joublanc a question. I believe you have covered it but I would like to have a review from you, Major. That is, in relation to cold work. You take a 3/32nds wire with the same heat of steel, a 3/32nds wire will be four draft; a 3/16ths is 2 draft; and 1/8th is 3 draft. So we have two, three and four draft wire. In your experience, I would like to know the relation of the stability, plasticity and fluidity due to that cold work that has been put into the wire. In other words, would you please review just what the action is of the 2 draft wire versus the 3 and 4 draft wire?

Mr. Joublanc: If I understood you correctly, I think you spoke about the change in the diameter, that is, as the change of the degree of cold work. We didn't do that. We got the one size wire throughout. In other words, the four draft wire was 3/16ths as well as the one draft wire, after annealing. But the way that was done was to simply draw it down without any anneal, to give it as severe cold work as we possibly could get. That isn't normal practice, I don't think. It was done experimentally. As far as the quality of the weld metal is concerned, there was no difference in the weld quality whether it was 1, 2, 3 or 4 draft. The only difference we noticed was that the arc tended to be wilder as the drawing increased.

Now perhaps this is true. You are going to have quite a bit of distortion, quite a bit of compression, right near the surface, anyway, wherever you have severe cold work. And it may be that right at that point there is a greater tendency for that metal to expand than if that condition of compression didn't exist. That is just a thought. I don't know whether it is actually true. But at least right now it sounds reasonable that because of the compactness of the metal right at the surface, it will expand a whole lot faster. And if it does expand faster, then that will account for this wildness.

I don't know whether that answers your question or not, Mr. Westphal.

Mr. Westphal: I can appreciate, Major, now that the statement you made in your lecture was experimental, but I was interested to know if you had seen a marked difference in the reaction of the 2-draft versus the 4-draft?

Mr. Joublanc: A very decided difference. And as for the welding operator whom I had to check that, I just gave him one wire and then another. He didn't know what they were. He would say, "This is wilder than this." And in every instance the greater the degree of cold work the wilder the arc. And then we supposed that the 2-draft wire was the proper thing. In other words, we are not going to recommend it, you understand, because there are other ways of doing it. This company that I referred to that supplies this very excellent welding quality wire, I don't know how they do it, whether it is 1, 2, 3, or 4-draft, but still it is perfectly all right. I merely brought this drawing proposition out because that is something that has been talked about quite a bit. I know even in our own organization the question comes up quite often.

Mr. Westphal: I might add I am sure we will be very appreciative of your work when you have finished your research and you subsequently publish it with this lecture.

Mr. Dove (Canada): Mr. Chairman, the speaker spoke of the amount of drafting in 1, 2, 3 and 4-draft wire. I was wondering, how these drafts are related to the percentage of reduction of area?

Mr. Joublanc: You mean on the wire itself?

Mr. Dove: Yes, sir.

Mr. Joublanc: Let me get that question again. The relation between draft and the percentage of reduction of area.

Mr. Dove: I should say that over-all reduction from the rod to wire.

Mr. Joublanc: I understand your question now. Unfortunately, I don't know. I merely leave it to these people who supply the wire. I don't know what sizes they start with. Presumably they started from the same size. I think your smallest size hot roll is a little over .2 inch.

Mr. Westphal: Two-fifteenths. (.215)

Mr. Joublanc: I wouldn't be able to answer your question on that. I wouldn't know just what size dies they drew that through in order to get it down to the specified size. But I call these men in and I say, "Here is the thing we want to do." They say, "All right, we will do that; we will give you the necessary degrees of cold work." And that is what we get. We have photomicrographs of that wire structure which would probably answer your question. So when you ask that when the investigation is reported in its entirety we will have all this information. I want to have the arc flare described in numerical values and I want to have, most of all, the photomicrographs, so you will know what we are talking about. So that when you see these things on the screen you will know just exactly what degree of cold work you've got.

Dr. Braley: Mr. Chairman, in that matter of drafting, isn't it possible that your differences may have come from the fact that you had intermediate annealing rather than the total amount of cold work to be done? In other words, if you would start and make 3/16ths wire out of, we will say, 5 rod or 3 rod, and two sizes larger, so that you have it drawing direct from the original hot pulled rod actually down to the final 187, where you have 1, 2, 3 and 4 drafts, do you think you would get the answer you obtained. Do you think you would get the same answer by taking the same and drawing at one draft and then annealing and repeating that operation until you

had the final one draft, which had been annealed three times?

Mr. Joublanc: Well, that is what we did.

Mr. Braley: Wouldn't that give you a different answer than if you take different rods and draw direct from the hot roll structure?

Mr. Joublanc: Could you do that?

Dr. Braley: Oh, yes, you can roll any size rod required.

Mr. Joublanc: Maybe I didn't make myself clear. That is the value of a progress report. You go so far and say, "Gentlemen, here it is." And then the audience will tell you what more you should do. That is why this is interesting. It is interesting to me because it will give me certain leads as to what might be done in the future. What I told these people to do is to take a certain size wire which could possibly be drawn in one pass to 3/16ths, just one draft. That was No. 4 wire, we will say. Well, then, No. 3 wire was drawn from, say, .215 down to some intermediate size, then annealed, and then drawn to another size, then annealed, and then drawn to 3/16ths, and that is No. 3, and so on.

Dr. Braley: That is exactly the point I am raising the question on. Now we will say you are making 187. If you are making it out of 5 rod you can do it in one draft. Now you can go up to another size rod out of the same heat of steel but you can't make it in one draft. You can do it in two drafts. And if you want to make larger rod you can do it in three drafts. And then you cut out your annealing and obtain a condition directly attributable to drawing.

Mr. Joublanc: In other words, your thought is, and it may be entirely correct, that the difference that we find is not due to the fact it has been drawn hard, but the fact it has been annealed more often.

Dr. Braley: Yes.

Now one other question relative to carbon. You stated you wanted low carbon. What is the relationship between the carbon in the wire and the ultimate carbon in the weld metal?

Mr. Joublanc: That depends largely on the coating.

Dr. Braley: Approximately, we will say, if we start out with an individual coating—we will say you have .06 carbon and .015 carbon. You apply to it the same coating and produce a weld metal. What will be the ultimate carbon in the weld metal?

Mr. Joublanc: From our experience, and we have had a lot of .15 carbon—and I am talking about the all-position rod because it is the most critical and the one with which all the work has been done—we will find the carbon will be about 10 if it is .15; and if it is .06, it will still be .06.

Dr. Braley: In other words, you tend to approach a definite equilibrium in the carbon of the weld metal, which is the same identical value as the carbon in the rimmed steel, which will be in the neighborhood of .08. And that will fluctuate slightly, depending upon the way it is laid down, the individual who has laid it down and the coating that is on it. And the same applies to the silicon.

Mr. Joublanc: The silicon in all metal is very high. It will run .15 in spite of everything.

Dr. Braley: Some will run as high as .35 and some will run as low as .08, but you always get the same silicon from a given coating.

Mr. Joublanc: It depends upon the amount of sodium silicates you use.

Dr. Braley: There are one or two other points on that. You have taken different steels and applied the same coating. Now, have you taken the same steels or same group of steels and applied four or five different coatings to see if it is possible, using the same series of steels and taking a half dozen steels and applying to them a half dozen different coatings, to see if in one coating you will have a rating from 1 to 6, we will say, or possibly by using another coating that you can completely reverse that order and it will be one to six in the opposite direction?

Mr. Joublanc: Oh, yes; sure.

Dr. Braley: On that basis, then, what is the function and the value of the coating as compared to the analysis of the steel itself?

Mr. Joublanc: Well, I think the simplest coating we have is mostly organic, not mostly, but a large portion is organic, and sodium silicates. So the result is something that is very close to what we would get if we welded with bare wire. It has the widest range of application. Now my idea would be to take this simplest coating, which we know gives us good properties, and then see what we can do with the wire phase of it and then apply that same coating to it and then extend that to these other two fields of welding that I talked about In other words, I very much doubt that we are going to go very much further with coatings. We have gone over this matter very thoroughly. Surely we can take fence wire and we can put a coating on it and it will weld all right. But I think the reasonable thing to do, at least this is my opinion, would be to make welding wire that has apparently all these characteristics we desire and then use the simplest coating on it that we can possibly get, and then I think a lot of our electrode ills will have been removed.

Dr. Braley: Providing everybody will use the same coating.

Mr. Joublanc: Well, why not?

Dr. Braley: They don't. That is the reason we have trouble.

Mr. Joublanc: And everybody else.

Mr. Johnson: (Bethlehem): You mentioned phosphorus in there. Did you give the minimum and maximum amounts of phosphorus?

Mr. Joublanc: You mean that we have used?

Mr. Johnson: That would give us the best welding quality?

Mr. Joublanc: I don't know the best, because we weren't in this investigation, so far as phosphorus was concerned, we weren't trying to find out what we could do to make use of it, but to learn what percentages of phosphorus would be harmful. We obtained up to .15 percent phosphorus by adding ferro-phorphorus in the coating and there was no harm done. So we felt safe because no weld metal would have over .15, and we stopped there. But I can assure you that weld metal having .15 phosphorus is not going to be bad for welding.

Mr. Braley: You say you went up to .15 in the coating?

Mr. Joublanc: In the weld metal.

Mr. Braley: In the final weld metal. I have gone not quite that high in the weld metal.

Mr. Joublanc: Do you agree with me?

Mr. Braley: Absolutely.

Mr. McCarthy: In connection with Dr. Braley's suggestion about the 1, 2 and 3 draft material, I would suggest also that you get those sizes from the same heat of steel.

Mr. Joublanc: These were.

Mr. McCarthy: Where you have three different rod sizes it will require special consideration in order to get it all from the same heat of steel from the steel mill. They are very apt to give you three different heats.

That leads up to another question. You said that the recommendation was to use large scrap instead of small scrap, small size scrap. And you seem to attribute that to oxidation. I am wondering, if you analyzed for carbon, manganese, sulphur, phosphorus and silicon, and apparently that is as far as you have gone? You referred to copper, and in your reference to the copper you said it didn't seem to do any harm but you didn't say whether they got variations as a result of the copper. I was going to suggest that there is a possibility that instead of just the large sized scrap as compared to the small scrap, that it might be the type of scrap. In other words, small scrap as a rule is a cheaper scrap and much more contaminated. It introduces a lot of chromium and a lot of alloys which are not in the large size, structural type of scrap. I think that in your study of welding that you will probably find if you had gone into it further that some of these residual metals, in the steels themselves, can play a much more important part than you would ordinarily expect they would. I think that probably would be well worth investigating.

You made another reference about manganese deoxidation. Are we to assume that you are referring to the killed steels or rimmed type steels?

Mr. Joublanc: Rimmed type.

Mr. McCarthy: That is a thing I never could quite understand in connection with any welding studies, as they sort of build up this question of oxidation and the influence of oxides on the welding properties. As soon as they accept rimmed steel, they accept the steel as being full of oxides, to begin with.

Mr. Joublanc: It may be more or less.

Mr. McCarthy. It has got to have a certain amount of oxidation or you can't make a rimmed steel. So you have to start out with a lot more oxides than you would ever expect in a killed steel. And when you have manganese in any quantities in the bath, the amount of deoxidation you get there is not enough to make your rimmed heat, you always have to supply it with a certain amount of aluminum additions in order to balance off your oxides in order to get a good rim. So you see that the addition of manganese or the amount of manganese in the steel doesn't in itself serve as an indication of oxidation or deoxidation.

Mr. Joublanc: Isn't this true, though? Supposing you didn't have such a low carbon specification and you let your carbon drop down to .07 or .08? You would have less oxygens in your bath than if you dropped it to .04. That is what I had in mind when I said that. In other words, the lower the carbon the more highly oxidized your bath is going

to be. And the more highly oxidized the bath is going to be the more manganese you are going to lose when you add it.

Mr. McCarthy: That is quite true. There is no question about that. Except when we get through we would balance off with approximately the same amount of deoxidation for a given rimming action associated with the subsequent pouring of the steel. You would balance that off with the aluminum additions in the ladle.

Mr. Joublanc: That is what I had in mind when I said aluminum. We have two firms supplying us with wire. We have more than two, but there are two that do this regularly. Sure, we will get .06 carbon, but we will also get .32 manganese, very consistently.

Mr. McCarthy: In itself that isn't so difficult to make, .06 or .07 carbon with .30 or .32 manganese.

Mr. Joublanc: We don't want that; we want .50 manganese.

Mr. McCarthy: You get down around .06 carbon with .50 manganese and you get into the carbon-ferro-manganese. That always presents a problem when these specifications come in. You don't consider silicon. You don't even consider it in connection with welding as a deoxidizer, do you?

Mr. Joublanc: The reason I haven't brought that in here is because we are doing a lot of work on it and we are not satisfied as to just the relation between the silicon content of the wire and certain behavior. Now before we said anything about it, we wanted to find out something of the form in which that silicon existed, whether it is in the form of silicate inclusions or whether it is dissolved silicon. We didn't know. But we do know this. And I think there is enough information to indicate that it is pretty nearly true that if you have a high silicon content, your wire would be inherently wild.

Mr. McCarthy: Don't you think that may influence sometimes the electrical behavior of the wire your conductivity or resistance or whatever you might want to call it? Don't you think that it might be a much more important factor than we think and induce the behavior at the arc by the way in which the current is transmitted through the electrode? You take cold worked metals and really when that metal finally is deposited all the cold work is lost so that the cold work characteristics will not be there. I think the only influence the cold work would have would be on the conductivity and electrical behavior of the electrode itself.

Mr. Joublanc: It is really more than conductivity. Until we know much more about the physics of the electric arc, we are not going to solve some of these particular problems. It may be conductivity all right, but it is the conductivity of the arc stream rather than conductivity of the metal itself.

Mr. McCarthy: I am inclined to feel that the analyses of the materials could be very important so far as conductivity of the arc stream is concerned, but I cannot appreciate how the cold work present in the metal can influence the arc stream itself because I feel that would have all gone before we got into the arc stream.

Mr. Joublanc: We will go over that very thoroughly again, particularly that phase of it. And I think I have more friends in the wire industry, or rather more people in this industry willing to help me out on this problem than I had before I came here. And instead of getting two lots of wire from two representative manufacturers, we will get ten of them. And then we will try to make this conclusive. I don't think it is so extremely important. We saw a difference but I think there are other things that are far more important. There is one thing to which we are limited and that is hardness of the wire, which will permit proper cutting. That was merely an observation that we made. But we found that if we didn't sacrifice too much by getting wire in four passes, that would be the thing we would want, because that is the difference in the behavior wire, whether it is drawn 1, 2, 3 or 4 passes, that is something that is of academic interest. But it is very important to have your wire so it doesn't look like it is off center because there you have some sales resistance right at that point.

Mr. McCarthy: There is just one more little contribution I will make and then I will sit down. In making a study of the E. M. F. generated in thermocouple wire, they found in making heats of steel it was very difficult to get the same curve as the temperature increases. The E. M. F. generated never is in a straight line as the temperature is raised. But even the curve they have set up for iron and iron constantine thermocouples, is hard to hold to and it is necessary to select certain heats of steel that will actually hold to it. The variation between heats does not follow the analysis at least not the analysis for the five commonly determined elements but the E. M. F. as indicated by the curve seems to vary with the presence of elements not usually analysed for.

Chairman Gundstrom: If there are no more questions, we will go to the next subject.

Mr. Joublanc: Gentlemen, I want to thank those of you who have voiced your opinions on this subject. That is precisely what I had hoped you would do. We had ideas of our own and unfortunately we had no one with whom we might discuss these problems. But you have come forward with certain very enlightening suggestions and criticisms, and we have notes of them and we will follow through them, and I will use one or two of the men in the organization as sort of a clearing house for the information I want to get out to the rest of the organization. And when we do present this paper in its entirety we will, as far as we can, illustrate most of the things that we are trying to talk about rather than getting up here and merely talking. I thank you. (Applause)

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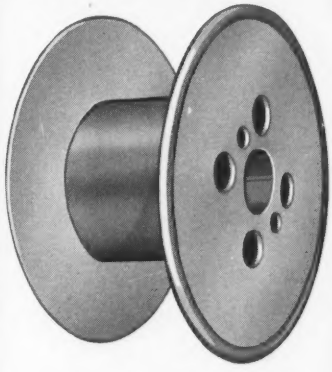

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Meeting, Monday, October 23, 1939 - 2:30 P. M.

Chairman of Meeting

E. W. GUNDSTROM, Plant Manager,
Rome Cable Corp., Rome, N. Y.

PAPER: "SUBMERGED HEAT BY SUBMERGED COMBUSTION"

WALTER G. SEE, Sales and Service Manager,
Submerged Combustion Co. of America, Hammond, Ind.

(Paper Published in October, 1939 issue of Wire & Wire Products - Page 533)

Chairman Gundstrom: The second part of the program is Walter G. See, Sales and Service Manager of the Submerged Combustion Company. Mr. See is going to talk about "Submerged Heat by Submerged Combustion". Mr. See (Applause)

. . . Mr. See abstracted his paper . . . (Applause)

Chairman Gundstrom: Are there any questions you would like to ask Mr. See?

Mr. Harrison (Atlantic Steel Co.): When your thermostat goes into play does the air go on through and do the agitating?

Mr. See: No, sir, the thermostat has nothing to do with the air. It controls only the gas. The air runs constantly after the starting button has been pushed until the stop button is pushed. The thermostat turns the gas on and off as heat is demanded in the vat. Does that answer your question, Mr. Harrison?

Mr. Harrison: When the gas is not burning, then the air is still going in. Does that cool the vat considerably?

Mr. See: It does cool the vat to a certain extent but in compressing air as close as we do to the place it is required it comes into the burner at approximately 130 to 135 degrees Fahrenheit so that it does not cool it off to a great extent.

Mr. Hussey (Jones & Laughlin): I have a few questions I would like to ask. Just how do you account for lower rejections in the cleaning house? And does any special inhibitor have to be used with this form of heating? Another question is, what is really the outstanding factor in increasing the tons per man hour? Isn't it the agitation rather than the form of heating or type of fuel used?

Mr. See: To answer your first question, what is the reason for the lower rejection, I would say this is entirely because of the constant temperature and agitation of the solution. With these two things remaining constant the pickling of a particular type of material will take approximately the same time which gives the foreman in the pickling house a much better yardstick in gauging his best pickling time for like material.

In answer to the second part of your question concerning inhibitors, we have not as yet used a special inhibitor on any job using submerged combustion. Any good standard inhibitor is highly successful.

The third question I believe was, what is the reason for the increase in pounds per man hour. I would say the reason for this is that with any wire pickling set-up there are a certain number of pins which can be placed in the vats at one time. If it is possible to pickle the steel faster it forces the pickler to pull the steel from the vat faster. After the steel has been pulled, a pin of unpickled material must be placed in the vats in the spot where the pickled pin was removed. This forces the man to work faster and over the day's period shows a decided increase in the amount of steel pickled. This raises the pounds per man hour figure because in the past the man has not been doing all the handling that he can do because of the time taken by the steel in the vat.

Mr. Hussey: That comes about by the agitation, doesn't it?

Mr. See: Yes, sir. Does that answer all your questions, Mr. Hussey?

Mr. Voigtlander (Union Wire Rope): Could this equipment be put into a circular wooden tub in which the rods go almost to the bottom? The flame goes right into the acid, doesn't it? The flame is actually in the acid. Would it burn the wood?

Mr. See: Well, to be truthful about that you know as much as we do about it because we haven't been able to see what happens at the bottom of the burner. But in burning this burner in the open we notice that we have a very short, sharp flame so we do not believe any flame goes directly into the acid—only the heated exhaust gases. It can be put into a circular wooden tank. There is no reason why the combustion chamber cannot be made to give the correct agitation in any tank. We have burned gas in a soluble oil tank and after checking with an orsat have shown that we do not burn any of the oil. Since this is so we can certainly burn gas in a wooden tank without burning the tank which is protected by the acid solution.

Mr. Buchanan (Republic Steel): How is the surface of the bars of this submerged combustion as compared with the steam agitation? I mean the smudge. Is it in better condition or about the same as without agitation?

Mr. See: I am very glad you asked that question because in the past we have had at least two customers claim that we put smudge on steel. In each case when we went into the matter the problem was solved by pulling the steel faster. In other words, we are pickling the steel faster than the pickler realizes. In the past when the steel is pickled the head picklers have refused to pull the steel because they do not believe steel can be pickled in such a short time. In so doing they allow it to over-pickle. We believe the first thing that happens before you get a deep etch on the bar being pickled is the formation of a black smudge on the surface of the steel. In all cases of this kind in the past, the smudge has disappeared when the time was changed to a shorter period.

Mr. Buchanan: Then you get a cleaner bar, is that it?

Mr. See: Yes, sir, I have been able to in one case get Cor-Ten sheets as white as regular carbon sheets, which they had never seen done before.

Mr. Westphal: I would like to ask a question. What are the dimensions for putting one of these burners in an already existing tub?

Mr. See: You mean the dimensions of the burner itself, Mr. Westphal?

Mr. Westphal: That is right. Does it just take approximately the same space that the already existant steam pipes take?

Mr. See: No, it will take a little more than that but in a coil pickle tank where the coils being pickled come down into the solution there is a pocket at the bottom of the tank between the two coils being pickled. In most coil pickle tanks the pins are usually set in the same position in the tank. It is highly feasible therefore to place a burner on the bottom of the vat between these coils. Under these conditions the burner can be so placed as not to be in the way of the coils being pickled.

Now as to the dimensions of the burner—a 5½ inch clearance is needed on the bottom run. The upright pipe is 6 inches O. D. with a top flange dimension of 7⅛ inches square.

Mr. Westphal: How far does it extend out in the tub?

Mr. See: About 8 inches is sufficient.

Mr. Westphal: 8 inches. And you say it is 7 inches wide?

Mr. See: It should be 6 inches wide. The top flange is 7 inches, but the pipe extending to the bottom of the vat is 6 inches.

Mr. Westphal: What are the dimensions at the bottom?

Mr. See: 5½ inches clearance is all that is necessary. In a coil tank we do not believe clearance is important be-

cause of the tendency of the coils to leave a space between two pins which is ample room for a burner.

Mr. Westphal: What is the relation to the steel to be cleaned to the capacity of the burner? Say you take a 5 pin tub. I assume probably one burner would do it.

Mr. See: Yes, sir.

Mr. Westphal: How about the steel closest to the burner?

Mr. See: We now have one 5 pin tank in operation. The burner is located as close to the center of the tank as possible but we do not find any difference in the speed of pickling at any coil position in the tank.

Mr. Westphal: How about the agitation? Is it uniform agitation?

Mr. See: Very uniform. Directly over the burner the agitation is up. Then it comes across the top of the vat away from the burner, down the sides and across the bottom back to the burner. The lower two-thirds of the solution flows toward the burner. The upper third moves from the burner.

Mr. Westphal: It is all coming out the base right at the middle.

Mr. See: Your air exhaust gases are blown out through holes in the combustion chamber and force the solution to come up. As it rises, the acid flows in towards the burner from both ends of the tub. This starts the solution in its swirling movement.

Mr. Westphal: You say you get the same, uniform agitation on the extreme left and extreme right there?

Mr. See: Yes, sir. That can readily be seen in pickling bars in a 40 foot tank. The burners with 20 foot centers fire straight across the tank and seem to agitate heaviest at each burner. If the bars being pickled are checked frequently during the pickling cycle it is impossible to notice at any time any difference in the pickling of the bars directly over the burners or in the center of the vat where the movement is away from the burners.

Mr. Westphal: What is the maximum temperature you can get?

Mr. See: That varies with the tank. We prefer 165 to 170 or 175 degrees Fahrenheit.

Mr. Westphal: What do you do when the pickling house is subjected to atmospheric conditions pretty much, where you might be down around zero weather? Do you have enough overload there so that you get enough heat?

Mr. See: When the data sheet is returned to us, all of that material is in that sheet and we figure our burner large enough to take care of the worst conditions.

Mr. Clifford (Continental Steel): Does the foot of the exhaust pipe extend clear across the tub so that the gases are being discharged uniformly?

Mr. See: Yes, sir, it can either extend clear across the width or in some cases the length. Now in a vat in a sheet mill, the picture of which you saw on the screen, the combustion chamber extends the length of the tank because it gives the best agitation and forces the acid solution through the entire length of the sheets.

Mr. Westphal: Can you draw a cross section view of that through the burner, to show us the relation of the nozzle?

Mr. See: You mean a cross-section view of the burner, Mr. Westphal?

Mr. Westphal: Yes, I mean of the tub, and then the relation of the burner in the tub. Draw the tub and then put the burner in.

Mr. See: There is the tub. Now in this case the burner lead in pipes containing gas, air and igniter wires would come across the top of the tub. The head of the burner is at the top with a cap and sight port so that it is possible to observe the flame. From this point the burner is run straight down the side of the vat to the bottom where it goes across the bottom of the tank. Close to the top of the down run is a flange where the combustion chamber is clamped to the burner. There are a number of holes in this combustion chamber. In most cases it is twenty ¾ inch holes. We also have little steps to keep the combustion chamber from lying against the bottom of the vat. As we depend entirely upon the solution to cool this lead combustion chamber with a flame temperature of approximately 2800 degrees Fahrenheit, these steps are necessary.

Mr. Westphal: The flame shoots straight up?

Mr. See: You mean here? The acid shoots straight up. The agitation is straight up from these holes.

Mr. Westphal: That projects out about 8 inches, you say from the side of the walls?

Mr. See: Yes, sir.

Mr. Johnson (Bethlehem): When one thinks of mechanical agitation he thinks of changing the position of the individual strands of rods so that new surfaces are exposed to the acid. You can agitate the rods in the tub or take the rods out and turn them in order to expose these surfaces. Will this type of heating eliminate the need for mechanical agitation?

Mr. See: When coils are pickled we always advise rolling the coils once during the pickling cycle. The reason is that where the coils are hung on the pin, the strands stick closer together. The agitation is heavy enough to open up the coils at the bottom and keep them flopping and moving constantly so the acid does get through them. If you have mechanical agitation submerged combustion will do the same in speeding up the pickling cycle as your mechanical agitation did in opposition to open steam jet heating. Now is that clear? I mean by that if it takes one hour to pickle with open steam jets it will take approximately thirty minutes with an agitator equipped tank or thirty minutes with the submerged combustion equipped tank, or if you have them both it is approximately fifteen minutes.

Chairman Gundstrom: Any more questions?

Mr. McCoy (Sheffield Steel): In this pipe system, is it durable enough to withstand certain mechanical abuses which might come from contact with the rods?

Mr. See: You mean, such as someone dropping a load on it? No. The burner itself is, yes. That is, the burner that extends into the combustion chamber, approximately thirty inches below the flange. That will take quite a jolt. We have had many cases of putting two or three tons on it without hurting it. However, when you put two or three tons on it you will oftentimes smash the lead combustion chamber at the bottom of the upright. Now sometimes if that tube is smashed a little too much it will not work correctly. If this is the case it is necessary to take the combustion chamber from the tank and either hammer it into shape or burn in a new section. After all, it is lead and is cheap.

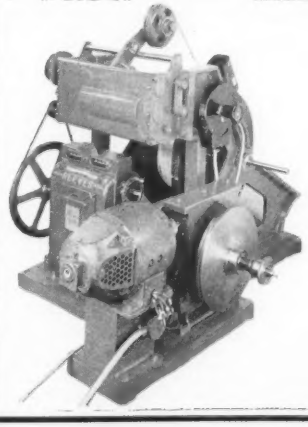
Mr. Westphal: It won't take much abuse, in other words?

Mr. See: Well, I think our equipment will take every bit as much abuse as any other equipment on the market. We do not recommend being particularly careful with submerged combustion equipment because it was designed in the pickling room and it has always been used and run there. We know what the pickler does to it. Now if by some chance a load is dropped on it naturally it is going to break down. After all, if a load is dropped on any piece of mechanical equipment, it will break down.

Mr. Buchanan: You say you have these units in operation here? Probably some of the men would like to see a unit in operation, if it is permissible.

Mr. See: I was going to finish my speech but you beat me to it and I got stalled on the way up here. It is supposed to be finished this way:

"In closing I wish to say that I will be pleased to make the necessary arrangements for anyone to see a complete pickling room in operation using no steam. I will be glad to take you there or tell you how to get there, and whom to see."



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FERROUS DIVISION

Meeting, Monday, October 23, 1939 - 2:30 P. M.

Chairman of Meeting
B. L. McCARTHY, Chief Metallurgist,
Wickwire Spencer Steel Corp., Buffalo, N. Y.

PAPER: "THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"

By STANLEY P. WATKINS, Manager,
Rustless Iron & Steel Corporation, Baltimore, Maryland

(Paper Published in October, 1939 issue of Wire & Wire Products - Page 527)

THIS PAPER RECEIVED THE 1939 WIRE ASSOCIATION MEDAL AWARD

The next paper on the program is entitled "The Manufacture and Use of Stainless Steel Wire." We are very fortunate in having as the speaker, Mr. Stanley P. Watkins, Manager of Sales Development of Rustless Iron & Steel Corporation of Baltimore, Maryland. Mr. Watkins, please.

Mr. Watkins: Mr. Chairman and members of The Wire Association:

Mr. Bates said he wasn't going to give a paper, but since this is my first appearance before The Wire Association, I think it would be better for me to read a paper as I'm not such a gifted speaker. . . . Mr. Watkins read his prepared paper . . .

Chairman McCarthy: Are there any questions on Mr. Watkin's paper? I suggest we move right along with them if there are.

Mr. Ward (Bethlehem): Did I understand you to say, Mr. Watkins, that your ingots were hammered down?

Mr. Watkins: No, I said in some cases they are, especially the high chrome high nickel alloys, where we may have difficulty in rolling. We don't always do it but sometimes it is necessary. For instance, our blooming mill has fixed draft rolls and we have difficulty in hot rolling alloys which will not take these drafts. In that case, they are forged down to about a six-inch bloom.

Mr. Ward: You mentioned in your talk that it is necessary for rapid heating of the billet before rolling into a rod. Can you tell us the necessity for that and the time interval recommended?

Mr. Watkins: It is not so important in the 18-8 alloys but it is quite important in the straight chrome grades, because they are very apt to become decarburized at high temperatures (2000-2150° F.), unless heated rapidly to the rolling heat. In other words, you only want to hold the billets at the rolling heat for the minimum time necessary to secure a uniform soak, and then roll as quickly as possible.

Mr. Ward: Would the standard practice in a rod mill furnace be satisfactory for that job?

Mr. Watkins: Yes. Although a more accurate control of furnace temperature is generally required.

Mr. Jackman: In cold heading stainless steel bolt wire. do you practice preheating before upsetting to increase the die life?

Mr. Watkins: No. Although we have given the idea some consideration, especially in connection with 18-8 for making square and hexagon head cap screws. Oftentimes difficulty is encountered in trimming the heads of the blanks due to the fact that during the cold heading operation, they harden up to a point where it is almost impossible to trim. I know there has been quite a bit of thought given to this subject but we haven't conducted any work on the problem as yet. We have talked about it with some of the bolt manufacturers but nothing has developed as far as I know. It should help, I would think, to preheat the wire to about 550°F. just before entering the heading die, especially those grades of stainless steel which work harden excessively when cold worked. However, die life would doubtless be a problem.

Mr. Jackman: Did I understand you to say, Mr. Watkins, with spring wire you get the highest tensile strength in 17-7 chrome?

Mr. Watkins: Yes. As you increase the nickel content in the chromium-nickel stainless steels their susceptibility to hardening by cold working decreases. In other words, by increasing nickel content the normally austenitic phase is stabilized and its tendency to break down into the ferritic phase is lessened. Carbon will also serve to stabilize the austenitic phase, although a high carbon content is not desirable for some applications.

Mr. Crane (Republic Steel): I understand with these lead alloy coatings, you are able to draw at higher speed than without any such coating.

Mr. Watkins: I know very little about ordinary carbon steel wire drawing practice but in the case of stainless steel, it is practically impossible to draw it without a coating of some sort. With no coating or a poor coating the wire will gall on the dies resulting in a scratched surface.

Mr. Crane: What are the average drawing speeds on wires down to, say, .105?

Mr. Watkins: Our practice is to draw at a speed of 100-150 feet per minute. However, we have on occasion drawn at higher speeds, but found that die life was materially affected as well as surface finish of wire.

Mr. Crane: Do you find you have to vary your drawing speeds with the straight chromes of 18-8?

Mr. Watkins: Not necessarily. As I pointed out, you can take heavier reductions on 17% chrome stainless and draw it somewhat faster than 18-8. However, our mill has found it convenient to use about the same drafts and speeds in drawing both grades.

Chairman McCarthy: Are there any further questions?

Mr. C. R. Wentz: Mr. Watkins, you mentioned lead alloy coatings. I wonder if you can tell us what that lead alloy coating is, how it is put on, how it is subsequently removed and whether any difficulty is presented there?

Mr. Watkins: When I referred to a lead alloy, I had in mind Amalloy, which I believe is an alloy of lead and tin. Our practice is to immerse the cleaned coils in a molten lead bath. After drawing the lead is removed by immersing in a solution of nitric acid.

Mr. Wentz: Plain nitric?

Mr. Watkins: Yes, about 30 per cent, warm. We have found it very important that every particle of lead be removed from the wire prior to annealing. Otherwise, the lead tends to alloy with the stainless at annealing temperatures and will cause deep pits. Our practice is to test each coil with chromate solution prior to annealing.

Mr. Wentz: Does the wire take on a uniform coating of lead, or just in spots?

Mr. Watkins: We have no difficulty getting a uniform lead coating on stainless wire. We only use lead for the roughing passes and very little wire is supplied to customers with lead coating. Copper coating is usually furnished on cold heading wire.

Mr. Wentz: Is the copper coating put on the same as on annealed wire?

Mr. Watkins: In our practice the copper is plated on the wire when it is in coil form. It is necessary to activate the wire before copper plating by dipping it in a solution of hydrochloric acid, otherwise, you won't get much of a bond between copper and stainless.

Chairman McCarthy: Before proceeding further, will the various gentlemen who have entered into this discussion leave their names with the Stenotype operator.

If there are no further questions,

(Please turn to Page 79)

FERROUS DIVISION

Meeting, Tuesday, October 24, 1939 - 9:30 A. M.

Chairman of Meeting

J. E. GIRVIN, Engineer in Charge,
Wire and Cable Department,
Canadian General Electric Co., Ltd., Peterborough, Canada

PAPER: "ENGINEERING OF CONTINUOUS STRAND EQUIPMENT"

By RODMAN R. TATNALL, Metallurgist,
Wickwire Spencer Steel Co., Worcester, Mass.

(Paper Published in October, 1939 issue of Wire & Wire Products - Page 559)

The morning session of the Steel Division of The Wire Association was called to order at ten o'clock, Tuesday morning, October 24th, 1939, by Chairman J. E. Girvin, in the Florentine Room of the Congress Hotel, Chicago, Illinois.

Chairman Girvin: Gentlemen, we will call the meeting to order, and without any further words we will ask Mr. Rodman R. Tatnall, Wickwire Spencer Steel Co., to proceed with his paper on "Engineering of Continuous Strand Equipment."

. . . Mr. Tatnall presented his prepared paper . . .

Chairman Girvin: Gentlemen, we have listened to a very interesting paper. If there is any discussion or any questions, will you please stand and give your name and the name of your company, so as to aid the reporter.

Mr. Kenneth B. Lewis: Have you given any thought as to what influence the growing practice of butt welding might have on these calculations?

Mr. Tatnall: I don't know that I just understand your question.

Mr. Lewis: Is not the butt welding of bundles back of a strand treating equipment going to raise hell with the chore time?

Mr. Tatnall: I don't think so. It does not seem to me that it would. Particularly on heavy wire, the way it is spliced is rather clumsy—bending a hook—bending a loop on the other end (to hook into it)—and if you can weld, I think you can weld as quickly as you can carry on the present method. As for going through the furnace and coming out at the other end, I should think it would be just as easy to break it off there or cut it in some way, as it would to run through the so-called splice. I will tell you, frankly, I have not had much experience with welding and how it would affect chore time, but I can't see how it would be very difficult.

Chairman Girvin: Are there any other questions, gentlemen? There should be some discussion on such an interesting paper.

Mr. Kenneth B. Lewis: I think this is a darned good paper. It must have taken a good deal of courage to write it, and in commenting on it, it is about as hard to try to review as Webster's Dictionary—there is too much in it. But each one of us, I suppose, sees his own angle.

There is a point in connection with strand operation, particularly a heating operation, such as patenting, that is always interesting to me. I wonder whether you, or any of the members here, have given any thought to it or gotten any data on the matter of the way the speed ought to vary with the size of the wire. I see Rod grinning. I suppose, again, that is out of his line.

Theoretically, a strand treating furnace, if it is a heating operation, ought to have a constant capacity. In other words, the speed should go up and down with the wire size—the speed should vary inversely with the square of the diameter of the wire because it should vary, of course, with the area of the wire. You have a certain tonnage of steel to be heated per minute but, on the other hand, all the heat forced into that strand has got to be put in through its surface. The surface does not vary with the square of the diameter.

So, assuming that a strand furnace, for instance, a patenting furnace is designed to handle No. 5 rod at a certain speed, at what speed would it handle 14-gauge wire, and at what speed would it handle 3/8 rod?

I have no doubt the speeds in current practice are based on cut-and-try. I wonder if anybody has ever collected them and collated them and made an effort to see whether they come nearer following the "squares" or the "first powers" of the diameter? I have tried it myself but I have not had very much data. The curve below No. 5 seems to run fairly close to the areas; above No. 5 it leans over and starts along towards the diameter. Have you any data on that? Has anybody any data on it? Has anybody any interest in it?

Mr. Tatnall: I think there is a good deal of interest in it, but I am not so sure where the data is. I would like to point out one thing, which I have just realized that I neglected before.

The figures in this analysis correction chart that I showed you were based on an exponent of 1. The constant was taken as 4 minutes per 1" diameter. That exponent 1 may or may not be right. In other words, with an exponent of 1, the heating time will vary as the wire size, obviously. Now, checking up the old standards, that heating law, that is, the heating time relation can be checked by simply figuring back and establishing the constant and the exponent. The exponent is not quite so easy to establish, but it can be done from the operating figures that you have. Doing that, we found an exponent something like .92, which derives for this cut-and-try experience.

I think that exponent depends entirely on what you are going to do. Take patenting—you have two operations—more, perhaps. In the first place, you have to heat the wire, and heat it long enough to get complete solution and, quite possibly, you also have to take into account a certain grain size that you want, which may take more time or less time, depending on the product.

On the other hand, in annealing you simply have to heat the wire and get solution, perhaps not complete solution, and you might have different results, especially when you compare the annealing treatment with the patenting and grain sizes.

In oil tempering you simply have to heat and get complete solution and you, obviously, don't want grain growth. I think that the exponent, as well as the constant, will vary depending on the nature of the operation, and I believe it will also vary depending on the method of heating. If you have a special furnace, such as an electric muffle furnace, and you pull the wire through that furnace so it does not touch anything—if you can imagine that for a minute—you will have practically 100% radiant heating.

On the other hand, if you have the lead pot, and you pull the wire through the lead pot, I believe you have practically 100% conductive heating—and the two different types of heating have a different exponent. I believe in the 100% radiant heating, the exponent is very close to 1, or is 1. On the lead pot type of heating, I am not sure. I hope to have something on that next year, incidentally.

Mr. Everling (American Steel & Wire Co.): I would like to make sure I understood the speaker correctly. Your entire analysis was based on the production of one unit per one man handling both ends of the furnace?

Mr. Tatnall: That is right. I can see I should have stuck a little more closely to the paper in each case. This analysis of a unit operated by one man handling

both ends. The same analysis can be made, of course, for a unit operated by two men, or six men. But when you take the chore time, you have to be very careful in your analysis to get the time that each man must spend on his particular duty, and to use the longest time, in case they are not equal. Then the analysis can proceed in the same way.

Mr. Voigtlander (Union Wire Rope Corp.): I was not here for the first part of the lecture, so I don't know whether you mentioned the fact that we might get at a method of plotting a curve of size of wire against length of time it stays in the furnace, by taking into consideration both the surface and the area, because, naturally, the heat gets through the surface first and then goes through the wire to the center. That is something I have often wanted to figure and have just let it go. I wonder, did you ever figure it?

"Member": The phenomenon of heat transfer is expressed by the differential temperature times the overall factor of heat transfer. In the case of reasonably small rods, the total heat transfer is practically a linear function of the diameter of the rod, regardless of its conductivity."

Chairman Girvin: Are there any further questions? Mr. Lewis?

Mr. Tatnall: This matter of heat transfer is, of course, in the realm of physics, and a lot of laws have been set up. There is another side to it, I think, that can be arrived at in the wire mill from the practical curve of wire speed or heat treating time, whatever you want to call it, but it is a very fertile field for work.

Mr. Lewis: As a matter of fact, in the case of patenting you very soon run into limits on both sides, don't you? If you try to speed up small wire in accordance with any formula you very soon get blocks running so fast that a man can't strip them. On the other hand, if you try to carry on with coarser sizes than the furnace is built for, you very soon reach a point where the heat input is not enough to heat your steel, and you feel those two factors before your reach the dead end.

What we need is not a theory but a practical curve showing how, in the average case, the speed curve will vary with changes of size in a process in which the speed and the equipment has been laid out for a certain focal size. Then we should have curves of some sort showing how coarser and finer sizes will react to that equipment.

Mr. Tatnall: It is rather interesting—if you are figuring, say, lead pot heating on very fine wire, your treating time in that case is a small fraction of a second, and you can't make a lead pot small enough, short enough, to pull the wire through at a speed you can handle, as Mr. Lewis pointed out, and still hit the time that the formula says you ought to have; you just can't do it. But, by and large, for the majority of sizes from, I think, ½", which is about as big as anybody goes, down to possibly .031 or .025, these laws can be followed without running into too much trouble except, again, as Mr. Lewis pointed out, if you take too long a furnace and set up your law, you get a speed that may be greater than the man can handle, because he has to work on that wire while it is going around the block. You can't expect the man to get all snarled up in himself: it is bad enough to get snarled up in the wire.

Chairman Girvin: Are there any other questions? Well, gentlemen, if not, we wish to thank Mr. Tatnall for his paper and answering the questions. We will now go to the second item on the program this morning, which is a motion picture by the Uddeholm Company of America, on the "Manufacture of Swedish Steel Rods". Mr. Enevik will answer any questions anybody wishes to ask, after the picture.

. . . . Motion picture shown . . .

Chairman Girvin: Have any of you gentlemen any questions to ask of Mr. Enevik regarding this film?

Mr. Voigtlander: I think it is the general opinion that we would like to have seen how they make wire over there. Don't they make wire over there?

Mr. Enevik: We manufacture wire, but we pay a lot more attention to the manufacture of good wire rod. We send it to America and they make the wire here. We know this country has a lot of very excellent wire mills.

Chairman Girvin: Are there any other questions, gentlemen? If not, we wish to thank the Uddeholm Company for this excellent film.

If there is nothing further, we will call the meeting adjourned.

. . . Adjourned at 11:40 A. M. . . .

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FERROUS DIVISION

Meeting, Wednesday, October 25, 1939 - 9:30 A. M.

Chairman of Meeting

B. L. McCARTHY, Chief Metallurgist,

Wickwire Spencer Steel Corp., Buffalo, N. Y.

LECTURE: "ATMOSPHERIC ANNEALING OF STEEL WIRE"

By DR. ALLAN BATES, Manager and JOHN GIER, Associate Metallurgist,
Chemical and Metallurgical Division,

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pennsylvania

(This Lecture Will Not Be Published)

The Wednesday morning technical session was called to order at 10:05 o'clock, Mr. B. L. McCarthy, Chief Metallurgist of the Wickwire Spencer Steel Corporation, Buffalo, New York, presiding.

Chairman McCarthy: The meeting will now come to order.

Gentlemen, you all are more or less familiar with the terms "atmospheric control" and "atmospheric annealing." We are quite fortunate today in having a man with us who is able to present to us some unique angles on this question of atmosphere control and it is with great pleasure that I present to you Dr. Allan Bates, Manager of the Chemical and Metallurgical Division of the Westinghouse Electric & Manufacturing Co. Dr. Bates.

. . . Dr. Bates presented the subject . . .

I would like to throw this meeting open for discussion and put no time limit on it, but I think that if Dr. Bates ever started to educate you fellows, he would be here for a couple of weeks, so since we have but a few minutes if there are any questions anybody would like to ask, I am sure that Dr. Bates will answer them to the best of his ability. This is about as good a demonstration of how to control atmospheres as I have ever seen or ever dreamed of, I guess. I didn't know you could do it.

Dr. Bates: I might make one more remark, briefly. This device in the form in which we have it here is more for scientific entertainment than anything else. The measurements which we are making with it have to do with the extension of the wire on heating or cooling. We see the possibility, however, of making a commercial form of the device with which we will measure, not extension, but electrical resistance, which is a very accurate, a very highly measurable characteristic. However, this is not beyond the laboratory stage yet; Mr. Gier is considering the idea of having a little chamber through which the furnace gas will go previous to the time it goes in the actual furnace. Somewhere in that little chamber we will have a wire extending between two posts, so rigged up that we can measure the electrical resistance of the wire and, by putting in a wire which is of approximately the same composition as that of the mass of steel that is being heat treated in the furnace, we will follow from instant to instant, exactly what is happening; whether decarb. is taking place, whether carburizing is going on, whether it is remaining neutral, etc. In other words, we will be looking at the steel itself as it is being affected by the atmosphere and we are not just measuring something in the atmosphere; we are measuring steel.

That is a long way from any commercialization. I don't know whether it will ever come about, but I think it is a possibility and I believe a rather interesting one.

Mr. J. K. Beeson (Pittsburgh Steel): Dr. Bates, in a matter of a minute and one-half, you have taken that wire from 0.85 carbon down to steel with a .06 or .08 carbon. You say in an open hearth it takes from eight to twelve hours. Do you think it would be practicable to tap out, I will say, a 0.75 carbon heat, draw it into wire and, in a minute and one-half, shoot it through these atmospheres and have fence wire, controlled to say, one or two points of carbon?

Dr. Bates: I hadn't thought about that kind of interest in the idea of treating wire. I wouldn't want to draw 100 tons of high carbon ingots into 8 mil wire, however. I think the cost you would run into there would be greater than the cost of doing the job in the ordinary way in the open hearth. I am sure your mill men would think so. It could be done, however, quite certainly. That is, you could draw that high carbon wire and then make anything you wanted to out of it thereafter.

Mr. Beeson: I would think that would be a debatable point. I would think it would be, as far as the cost is concerned, cheaper to draw your high carbon wire and anneal it to low carbon wire.

Dr. Bates: Why don't you try it on a heat?

Mr. Beeson: If you will provide the atmospheres and the apparatus free, maybe we will.

Dr. Bates: It would certainly be technically possible. Whether it would be economic, I don't know. That would have to be worked out, of course.

Chairman McCarthy: There is one question I would like to ask. That is, as the CO_2 content decreases, isn't there a range in there where we get black smut on the wire, where you get darkening and some carbon deposit on the material? I mean smut from CO_2, as the CO_2 content decreases and your degree of burning decreases.

Dr. Bates: As for the CO_2, I think the richest CO_2 gas I showed there runs about 10 per cent.

Chairman McCarthy: Well, I am thinking as we come down to six per cent, we find that six per cent CO_2 is a pretty good range for annealing. Now, suppose we were to drop the CO_2 to three per cent? We haven't investigated that low range but I understand we should expect to run into some actual free carbon.

Dr. Bates: I don't think the question can be answered just in that sense. The effective factor is the CO_2-CO ratio.

Chairman McCarthy: Yes, the CO_2-CO ratio. We only measure it by CO_2, because it is the easiest.

Dr. Bates: Yes, most furnace atmospheres are measured by taking some particular feature like CO_2 content or the thermal conductivity of the gas and measuring that. Actually, you don't know from what is occurring in the steel, except very empirically, and I think this device we have here, in principle, at least, promises the possibility of knowing what is going on in the steel.

Now, as to your question, Mac. I don't know that I could answer it. It will depend on the steel, on the temperature, etc., because the equilibrium constant of any CO_2-CO ratio varies with all such factors, so that your question is pretty complex and can't be answered quite as simply as it is put.

Chairman McCarthy: I have been advised that we should expect some carbon deposit, that is, some free carbon deposit on the stock as we drop the CO_2 content much lower.

Dr. Bates: I haven't actually observed that.

Chairman McCarthy: All our conditions are more or less constant and, in fact, the material that is being annealed is more or less constant and, by using the CO_2 as an indicator, we get rather constant results and, for normal operation, we can just run it to 5.8 or 6 CO_2 content and we get uniform results. In other words, it is a simple control.

Dr. Bates: You are talking there largely about relatively low carbon steels. In high carbon steels, your reactions get much more critical.

Chairman McCarthy: Yes, I can appreciate that.

Dr. Bates: Those who are trying to avoid decarburization in spheroidizing I think can bear that out.

Mr. Donnachie (Geo. W. Prentiss Co.): How can you be certain you are holding Zero CO_2?

Dr. Bates: The CO_2 you must take out. You must take it out in tetramine or monoethanolamine or some other absorbing medium. As to whether it will stay near zero or not depends upon your maintenance. If the system is properly watched and regulated, you can stay very close to zero very consistently. We know that it is being done in a number of Westinghouse installations that we have out. It can be done and is being done commercially.

Mr. Galloway (B. Greening Wire Co.): There has been some work done on a straight nitrogen atmosphere. I wonder if you can tell us anything about that?

Dr. Bates: A pure nitrogen atmosphere would be fairly close to an ideal atmosphere. That is, it represents a very inert gas. There are other inert gases, such as helium, but they are commercially not feasible. One difficulty about getting nitrogen is that if it is to be inert, you must free it of all moisture, and tank nitrogen is by no means free from moisture. Tank nitrogen is expensive. I can't tell you, off hand, what that would run per 1000 cubic feet. I think possibly I have a slide which may show that.

Straight tank nitrogen—these figures on this slide are the approximate costs of gas atmospheres in dollars per thousand cubic feet and at the top there is nitrogen, the one you inquire about. Per thousand cubic feet, you will see that is a very expensive gas, $11.00 per thousand. Now, that cost is going to vary and get still higher if you try to purify it and take full advantage of the inertness of the nitrogen. That is, you have to take all moisture out. With that accomplished, nitrogen is a splendid gas for many purposes.

There has been some question as to whether or not even pure nitrogen may not nitride a little bit. I think it is highly questionable but some experiments have shown, or at least alleged — I haven't studied it — that even pure nitrogen may, under certain conditions, give you traces of nitriding, which may cause undesirable effects in some steels.

You can get pure nitrogen of course, by combustion of dissociated ammonia. Taking dissociated ammonia straight, it would run about $3.50 a thousand and would consist of 75 per cent of hydrogen and 25 per cent nitrogen. If we burn that ammonia with air, which is 80 per cent nitrogen and 20 per cent oxygen, of course, the hydrogen will be used up entirely in that combustion, forming water, and all the nitrogen of the air and all that of the gas would then appear as nitrogen. You would still have to take that water out and that is going to be quite a volume of water.

Finally, we can make a very close approach to a "straight nitrogen atmosphere" by means which Westinghouse already uses successfully in its own work and which is represented by several other successful industrial applications which we already have in operation. This consists of complete combustion of natural or city gas, using a high air-to-gas ratio. The burned gas is then led through a monoethanolamine scrubbing system to effectuate complete removal of CO_2. It is also dried thoroughly and the resulting gas will then comprise about 99% nitrogen, ½ H_2 and ½% CO. This cost of this gas will run somewhere in the vicinity of 30 to 50 cents per 1000 cu. ft. I think that for most purposes, we can consider it as a nitrogen atmosphere in which the very small quantities of residual impurities, hydrogen and carbon monoxide, are so balanced as to have no effect in most heat treating operations.

In principle, then, nitrogen is an excellent gas. In practice, to actually take advantage of its excellence, it is not so easy, because you must purify it, and that purification must be carefully controlled. However, there are operations for which it is very useful.

Does that answer your question?

Chairman McCarthy: Are there any further questions? If not, I think we should move along. I certainly want to express the appreciation of The Wire Association to Dr. Bates for this very fine lecture. It certainly is a unique demonstration and I am sure we all appreciate it. Thank you, Dr. Bates. (Applause)

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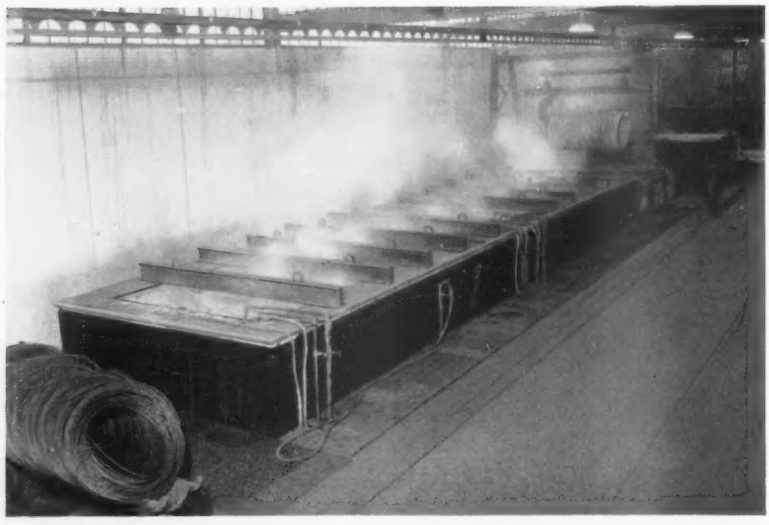

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NON-FERROUS DIVISION

Meeting, Tuesday, October 24, 1939 - 9:30 A. M.

Chairman of Meeting

WILLIAM A. SCHEUCH, Vice-President,
Nassau Smelting and Refining Co., Tottenville, S. I., New York

PAPER: "COATING WIRE WITH PAPER PULP"

By J. S. LITTLE, Manufacturing Engineer,
Western Electric Company, Kearny, New Jersey

(Paper Published in October, 1939 issue of Wire and Wire Products - Page 575)

Chairman Scheuch: Gentlemen, we have two papers this morning, one relating to "Coating Wire With Paper Pulp," and the other to "The Brazing of Copper."

I take pleasure at this time in introducing to you Mr. J. S. Little, Manufacturing Engineer of the Western Electric Company, Kearny, New Jersey, who will tell you about a development which has been made at the Hawthorne Plant of the Western Electric Company, Chicago, Ill. It is fitting, therefore, that this be given at a Chicago Meeting. Mr. Little.

. . . Mr. Little abstracted his paper . . .

Chairman Scheuch: I think it is rather inspiring to most of us who deal with the metal which goes into cable to see how it is handled by the user, how he covers the material before it becomes of real service to man.

I believe there is one point which Mr. Little did not stress and that is that this modification in manufacturing has made it possible to give more service to more people without an increase in the cost of the service.

The meeting is now open for discussion and Mr. Little will try to answer your questions: and if he can't answer them now, I am sure he will be glad to do so in writing later on.

Are there any questions?

Mr. Bouvier (General Cable Corp.): I should like to ask Mr. Little for a little more detail about the electrolytic method used; what voltage and current is used, and exactly what is the solution loss?

Mr. Little: We used to use a solution of 2% cyanide but now we are using the same percentage of ortho-silicate with about 1% by weight of Ivory soap which creates the foam. The voltage is about 12 volts. It may vary, depending upon the size of the wire and activity that is wanted. The solution heats up due to the passage of the current. The operator generally reduces the voltage to cut down the violence of the reaction. The current density is about 8 amperes per square inch.

Mr. Bouvier: What is the temperature of the solution?

Mr. Little: The temperature of the solution is close to the boiling point.

Mr. Bouvier: How long a time is it immersed?

Mr. Little: A very short time. The wire is traveling 130 feet a minute. It just passes over the surface of the solution, the actual contact being about 8 inches. I can't tell you the exact time. You can figure that. About 1/130th of a minute.

PAPER: "THE BRAZING OF COPPER"

L. L. WYMAN, Research Engineer,
General Electric Company, Schenectady, New York

(Paper Published in October, 1939 issue of Wire and Wire Products - Page 565)

Chairman Scheuch: I think it would be well at this time to go on with the next paper, which incidentally is related to Mr. Little's. At this time we will have Mr. L. L. Wyman of the General Electric Company, who is going to tell us about the Brazing of Copper. Mr. Wyman.

. . . Mr. Wyman abstracted his paper . . .

Chairman Scheuch: This paper is now open for discussion and we have quite a few people here interested in this kind of work. Mr. Eastlake have you any questions?

Mr. Eastlake: I can only say thank you very much for an interesting and instructive paper.

Mr. Rolle: I would like to ask Mr. Wyman just as a matter of general information what is the difference between brazing, soldering and welding insofar as they concern the non-ferrous metals?

Mr. Wyman: I don't know, Mr. Rolle, but I think you are going to become embroiled in the matter of terminology more than anything else. Possibly all I can do in that connection is to give you my ideas. Soldering, to my mind, is where you use the low melting alloys, usually the lead or bismuth or tin combinations.

Brazing, as the name indicates, is restricted to the use of brass or modifications thereof. And in that I include all of the silver brazing alloys even though their compositions may be quite remote

from the copper-zinc combinations. Take for instance the silver-copper eutectic which is widely used as a brazing alloy; it is really not a brass but still it falls into that class.

Welding—I usually like to put into that category all cases where arc methods of joining are used or where the same materials are united by fusion without anything extraneous being added. Of course, you can find conditions where one kind of joining overlaps another. Just what we are going to call that I don't know.

I know that silver brazing alloys are quite widely known as silver solders, but I don't like to consider them as such. When anybody says solder to me, I immediately think of lead-tin and I believe most everybody else does too. Perhaps the correct terminology for the copper-silver alloys used in jointing is silver brazing alloys, regardless of the exact composition.

Mr. Rolle: Then according to your definitions is copper ever welded?

Mr. Wyman: Oh, yes, copper is welded. As a matter of fact, if I recall correctly, there is a paper on the welding of copper to be presented before the Welding Society.

Mr. Rolle: Then I would say you confined yourself entirely to brazing in your paper; you did not attempt to cover the entire field of jointing copper.

Mr. Wyman: No; I think that is a much larger subject.

Chairman Scheuch: Any other questions?

Mr. Little: In connection with brazing, do you frequently use a flux?

Mr. Wyman: A lot will depend on what kind of brazing alloy is used. For instance, if you are using an alloy which has considerable amount of phosphorus in it, the phosphorus in itself will act as a flux for cleaning purposes and no outside flux will be required. If, on the other hand, in making the assembly the copper happens to be extremely dirty or a lot of insulation has to be cleaned off, a flux must be used. This flux not only acts as a scavenger, but due to the fact that it melts at a lower temperature than the metal, it remains liquid after the solder has solidified. Besides, the flux being lighter than the metal, the solder goes to the bottom and the flux remains on top to form a protective coating against oxidation.

As to the kind of materials, we use in the main the proprietary alloys, such as Sil-Foss, which has about 5% of phosphorus in it. A large portion of that is lost during the brazing operation. The phosphorus acts as scavenger and does a very good job of cleaning and therefore no flux is necessary. On the other hand, you can go to the straight copper phosphorus alloys, although there are many drawbacks because of the brittleness of the resulting joint. About the most phosphorus you can safely use is around 8% but the loss of phosphorus during the operation will probably bring the effective phosphorus down to around 3% or below.

Mr. Whitney: I believe that one of the brazing compounds that you recommend had 80% copper, 15% silver and 5% phosphorus, and I believe you said, it had very good electrical conductivity.

Mr. Wyman: Yes, it has good electrical conductivity in the finished joint.

Mr. Whitney: In view of the fact you have 5% phosphorus to start with and even though you lose a certain amount of that, I would think your residual phosphorus would still be high enough to prevent your getting satisfactory conductivity.

Mr. Wyman: I think this table shows the conductivity of that alloy. The actual conductivity of the alloy itself is about 3.9%, but that is not the conductivity of the joint, which is made with an overlap. The finished product has very high conductivity. You do lose a lot of phosphorus, but that is desirable.

Mr. Whitney: But you still have, say, in the neighborhood of 3% phosphorus left in the brazing alloy.

Mr. Wyman: It is something less than 3%. With the straight copper-phosphorus running about 8% or 9%, the residual would be something below 3% Mr. Ettelson, what do you guess is the residual phosphorus?

Mr. Ettelson: That, of course, would depend on the time and the temperature. We would approximately use about 1% or 1½% of the phosphorus. Now I think we figure about 3 to 4%. The loss of phosphorus is very high.

Mr. Wyman: Starting at 5.

Mr. Ettelson: Starting possibly with your 80-15 and 5.

Chairman Scheuch: Does that answer your question? If it doesn't, you had better keep after him because after we quit here it is commercial. Are there any further questions?

If not, I think we can bring this meeting to a close. We have had a very enjoyable morning and have learned some things which were foreign to many of us. I suggest that we give a rising vote of thanks to the speakers.

. . . Adjourned at 11:30 a. m. . . .

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NON-FERROUS DIVISION

Meeting, Wednesday, October 25, 1939 - 9:30 A. M.

Chairman of Meeting

R. G. BOWMAN, General Superintendent,
International Smelting and Refining Co., East Chicago, Ind.

PAPER: "ELECTRIC RESISTANCE WIRES"

By DR. C. L. MANTELL, Technical Director,
Wilbur B. Driver Company, Newark, New Jersey

(Paper Published in October, 1939 issue of Wire and Wire Products - Page 543)

The Wednesday Morning Non-Ferrous Session was called to order at 9:55 o'clock, Mr. R. G. Bowman, General Superintendent, International Smelting and Refining Co., East Chicago, Indiana, presiding.

Chairman Bowman: The meeting will come to order, please.

Our first paper will be "Electric Resistance Wires," by Dr. C. L. Mantell, Consulting Engineer, Wilbur B. Driver Company, Newark, New Jersey. Dr. Mantell.

. . . Dr. Mantell abtracted his paper . . .

The paper is now open for discussion. Are there any questions?

Mr. Scheuch: I would like to ask Dr. Mantell if he controls his impurities by analytical methods through his raw materials or by spectographic methods applied to his final product? We appreciate the importance of controlling certain elements called impurities and at times they are not the common ones which have to be controlled.

Mr. Mantell: The industry in general uses the common method of raw material control in that all materials are bought to specification. But with one additional factor. Spectographic analysis doesn't always tell us what we want to know and we finally have to come down to a situation in connection with a raw material like chromium for which we write the most rigid specifications that we can. And then obtain lots of the various batches of chromium and actually run them right through the plant. We know that some of them will work and some of them won't work. And we are totally unable to tell you why they will or will not work. We have tried to carry it through to determine whether it is nitrogen content or oxide relationship content. We are unable to track it down to any one material or any group of materials which is there as an impurity in the chromium. We do know, however, that we can make certain materials work with a definite melting practice and others we can't. We know that we can then change our melting practice, which you can appreciate is a rather complicated series of deoxidizing treatments and then we can make that batch work. However, in order to save time we can give the lot of raw material a plant run and then reserve the entire lot and say, "Thank you for letting us see the others, but we are not interested."

On our final material, spectographic checks are run periodically but there it doesn't tell us as much as a life test or performance test. We can detect differences by life test methods which are greater than spectoscopic differences would apparently indicate. The spectoscopic difference might be 25% and the performance test might be as much as 100%.

Chairman Bowman: Are there any other questions? If not, we will go on to the next paper.

The next paper is "Wire Solder—Its Manufacture and Uses," by Robert A. Gardiner, President, Gardiner Metal Company, Chicago, Illinois.

. . . Mr. Gardiner abstracted his paper . . .

PAPER: "WIRE SOLDER — ITS MANUFACTURE AND USES"

ROBERT A. GARDINER, President,
Gardiner Metal Company, Chicago, Illinois

(Paper Published in October, 1939 issue of Wire and Wire Products - Page 551)

Mr. R. L. Barry: May I ask, would you mind giving a little information on tin with about 3% copper? Or would you prefer to wait until after the meeting.

Mr. Gardiner: I would be glad to answer it if I could. However, in our particular field we don't use anywhere near that proportion. In fact, copper is the thing we don't want in there at all. Our machines for extruding and sizing are so delicate the copper would be objectionable.

Mr. Barry: A solder that has a high melting point, at what point does it melt? or when does it melt and when is it a solid? In other words does it have a mush range?

Mr. Gardiner: In soft solders that particular alloy is known as eutectic. That has been disputed, whether it is 63% or 64% of tin. I think it is most generally accepted as being 63% tin and 37% lead. All solders start to melt at 356.8°, or 357°. That is true of 6337, or the eutectic alloy. That starts to melt and is completely liquid at that particular temperature. As you go up in tin and lead content that temperature rises. There is a semi-solid state and it doesn't become completely liquid.

Mr. Barry: I thought you had higher temperature solder that does not have a mush range, like 25 tin and 75 lead.

Mr. Gardiner: That has a very heavy, mushy range.

Mr. Barry: I know it does but I thought you had a higher temperature solder, probably tin with a little copper or probably some antimony, that melted 120 or 125 degrees higher and did not have a mush range.

Mr. Gardiner: I don't believe that would come under the group of soft solders as we understand them in tin and lead. That goes over into the hard solders.

Mr. C. S. Adams: Mr. Gardiner, I would like to ask if the wheel method of making solder is used to any extent now days?

Mr. Gardiner: I happened to see one of those in operation a short time ago. It is the only one I know of that is around. It was very crude in its operation. They really defeat the purpose of the old wheel method of making wire solder in that they make crude wire and then they draw it into their sizing die.

Mr. Adams: Is it not a cheaper process?

Mr. Gardiner: It is cheaper because they don't have the investment of the machine.

Chairman Bowman: Are there any further questions or suggestions? In discussing this interesting paper with Mr. Gardiner before the meeting, he pointed out that the most interesting phases of the solder field were those that could be brought out best by discussion. I am sure that they will be brought out if the discussion will come forward to that extent.

If there is no further business or questions, the meeting is adjourned.

. . . Adjourned at 10:25 a. m. . . .

ACID DISPOSAL SYMPOSIUM

General Meeting, Thursday, October 26, 1939 - 9:30 A. M.

Chairman of Meeting

J. K. BEESON, Asst. General Manager of Sales,
Pittsburgh Steel Co., Pittsburgh, Pa.

SYMPOSIUM: "THE DISPOSAL OF WASTE ACID"

(Paper Published in January, 1940 issue of Wire and Wire Products - Page 30)

The session on the "Symposium on the Disposal of Waste Acid" of The Wire Association was called to order at 10:15 Thursday morning, October 26th, 1939, with Mr. J. K. Beeson presiding.

Chairman Beeson: We will open this meeting now. It is going to be informal. We are very fortunate this morning in having with us a gentleman who is probably more familiar with this problem than anybody else, owing to his research work and constant study on it. The gentleman who is going to talk to you this morning, briefly, and then informally answer questions, is Dr. W. W. Hodge, Research Fellow of the American Iron and Steel Institute at the Mellon Institute of Industrial Research at Pittsburgh. I think Dr. Hodge has a little review of what has transpired, and after his talk and slides, we will get into the questions. Dr. Hodge.

Mr. Hodge: Mr. Chairman, members of The Wire Association, and guests: Many of you are probably acquainted with the work we started at Mellon Institute, a little over a year ago. The American Iron and Steel Institute established a Fellowship at Mellon Institute to focus and encourage the efforts of the iron and steel companies in their endeavors to solve the waste pickle liquor problem; to get all the information together and find as satisfactory a solution as possible to this age-old waste disposal problem.

The purpose was to make a survey of the waste materials in the iron and steel industries, with special attention to the spent pickle liquors — to study what had been done and see what possibilities there were for the development of a technically and especially an economically satisfactory process for the treatment of waste pickle liquors. During the first year, we have made an extended investigation of what has been done on this problem, and have also carried on considerable experimental research work.

The Fellowship is in charge of the Special Committee on Stream Pollution of the American Iron and Steel Institute. The committee is composed of the Presidents and Vice Presidents of seven large steel companies. Dr. R. E. Zimmerman, Vice President of U. S. Steel Corporation is Chairman of the committee. Are there any questions?

(Dr. Hodge then presented a lecture "The Disposal of Waste Acid" illustrated by lantern slides. This lecture is published in the January, 1940, issue of "Wire and Wire Products.")

Chairman Beeson: I certainly think that was very interesting, Mr. Hodge. I am sure everybody will get a lot out of that. Has anyone any questions to ask Mr. Hodge?

Mr. John C. Callaghan: You say it was spent acid that was used for that, or was it copperas?

Mr. Hodge: Down in Alabama?

Mr. Callaghan: Yes.

Mr. Hodge: That was copperas. They get the copperas at the wire mill. It is just a short haul over to the sewage plant. The copperas is chlorinated for use in treating the sewage.

Mr. Callaghan: Do you know where there is a unit that takes the spent acid and uses it with reference to sewage disposal?

Mr. Hodge: I do not know of any such plant. However, it is reported that the chemists and engineers of the Chicago Sanitary District are doing considerable research along that line. Possibly it is a coming application for this waste material if we can assure the officials of the water-works and sewage disposal plants of a uniform supply of iron sulphate at a reasonably low delivered price. In many cases this may involve adjustment of freight rates. I understand the large Minneapolis-St. Paul sewage disposal plant put into operation last year was designed for using some chlorinated copperas, but they found they could not get the copperas near-by. What is believed to be the largest chlorinator assembly for any sewage disposal plant in the world was installed there for the various purposes of modern sewage treatment.

Mr. Callaghan: I was thinking more of a city of about 150,000 where a supply of spent acid was reasonably assured, and the problem of getting the city officials to think in terms of using that rather than putting it down through the sewers.

Mr. Hodge: In Phoenix, Arizona—I do not know the size of that city; probably about 50,000 population — the Consulting Chemical Engineer, Mr. Harmon E. Keyes, was in to see me about six weeks ago. He has developed a process there in which he is taking a ferrous sulphate solution, making ferric sulphate, and using that in the treatment of sewage. The city officials of Phoenix have, after studying all types of sewage disposal systems available, decided the Keyes process was the best one for them to adopt in the new sewage disposal plant they are starting to install.

Mr. Callaghan: You think there is a possibility of the municipal authorities using just the spent liquor? I am not talking about anything recovered, simply the spent liquor.

Mr. Hodge: The spent liquor can be made into ferric sulphate by this process used in Phoenix, and that is said to be better coagulant for sewage than ferrous sulphate. However chlorinated ferrous sulphate gives very satisfactory results and experiments are in progress on using chlorinated spent pickle liquor. El Paso, Texas (population of about 110,000) is a long distance from any waste pickle liquor. Recently the city officials installed a process for making ferrous sulphate solution from scrap iron and sulphuric acid. The solution is chlorinated and used in treating the city sewage. This system is saving the city around $3,000 per year in the operation of its sewage disposal plant over the previously used ferric chloride process (4-c).

Mr. Callaghan: Is that an expensive process?

Mr. Hodge: No. It is much cheaper than any other I have seen, provided the costs for the waste pickle liquor, copperas and chlorine are not too high.

Mr. Callaghan: Is it a process the municipal authorities could easily perform themselves?

Mr. Hodge: I think it is. It is not a complicated process.

Mr. Callaghan: Thank you very much.

Mr. Hodge: You are welcome. Down in Tampa, Florida, Mr. Lyles is consulting chemical engineer for the water supply in the city and he has worked out a ferric sulphate process for their use. There is no pickle liquor near, but we have been informed he takes scrap iron and tin cans which the city Garbage Department collects, treats them with sulphuric acid, and makes iron sulphate, and then bubbles sulphur dioxide up through the solution, chlorinates it, and gets this chlorinated ferric sulphate, and has reduced the cost of purifying the Tampa water supply by a good many thousand dollars a year. That is a development of the last three or four years; so it looks as though there are possibilities for certain steel companies to work with the municipalities and develop a system of utilizing the waste pickle liquor. They are using chlorinated pickle liquor, copperas, or ferric sulphate in Akron, Birmingham, El Paso and Tampa, and they are going to do it in Phoenix. St. Louis has been using iron salts for that turbid water they obtain from the Missouri River.

The Coney Island sewage disposal plant —largely a summertime operation—uses chlorinated copperas.

When I visited the Baltimore sewage disposal plant last spring they were constructing a $5,000,000 addition to that plant, and have put a large building in which chlorinated copperas will be used to condition the sludge. The old plant is the trickling filter type. They are apparently getting away from that process and combining the activated sludge process and chlorinated copperas for treating the sewage.

So, there are possibilities of using some of the waste pickle liquor, but when you come down to the amount that can be consumed, the figures are small compared to the quantities available. Estimates of waste pickle liquor made in this country vary from 500,000,000 to 800,000,000 gallons a year. It would take a pretty good market to utilize all that material.

Suppose this waste pickle liquor contained 3% acid and from the continuous process the free acid runs higher than that, and 15% iron sulphate, which is rather low for sulphate. On the basis of that composition and assuming 500,000,000 gallons per year, there would be 75,000 tons of sulphuric acid run into the streams which, at $10 a ton, would be $750,000. Then, there are 686,250 tons of copperas in the waste pickle liquor. Of course, if they could sell the copperas at $10 a ton, the iron and steel companies might make some money on it. The trouble is the comparatively limited market for copperas.

We may have to process some of the waste pickle liquor back to sulphuric acid and iron oxide. In my opinion, the problems in different cities vary. In some cities there might be a large market for construction materials of the Ferron type, in other localities the demand for iron oxide paint pigments or glass polishing rouge, or copperas for agricultural purposes might warrant the installation of processes to manufacture those materials from the waste pickle liquor. Local and district conditions of supply and demand should always be investigated before adopting a process for treating the spent liquors.

In some cities it may be possible by cooperation with the municipal authorities to use a good deal of the pickle liquor, or copperas in water purification and in sewage treatment. In some cities they have textile factories, paper and pulp mills, food and other organic products industries. Some preliminary experiments indicate that waste pickle liquor or copperas may be useful in treating certain kinds of organic industrial wastes. A representative of one of the largest food canning companies in the country came to see me about two weeks ago. They have plants in the Southern States. We tried the effects of adding some waste pickle liquor to a food factory waste and it cleared the cloudy suspension just as nice as could be. The State Health Department has informed the officials of the food factory that the waste material can no longer be discharged into the adjacent river. The difficulty is that the food factory is a long distance from any steel mill. I told them that there are some steel mills in the Birmingham District which manufacture copperas. It is not such a long haul from there to the canning plant, and they might be able to work out a satisfactory system for treating the wastes from the food factory with chlorinated copperas.

The Director of Research for one of the large paper companies, which has ten or twelve big mills through the East and South was in to see me. We treated some of the pulp mill waste with some waste pickle liquor. A large amount of material coagulated and precipitated leaving a clear, nearly colorless supernatant liquid. So there are possibilities of developing uses for considerable of the waste pickle liquor or copperas but it still leaves large quantities for disposal or for possible newly discovered uses. Hence, it may become necessary to process some of it back to sulphuric acid and iron oxide and if that necessity arises, "community" sulphuric acid plants or cooperative agreements with chemical companies may be advisable. Thank you.

Chairman Beeson: Mr. Hodge, you mentioned one process where you reclaimed iron oxide and charge it back into the furnace. Is that a very expensive process?

Mr. Hodge: The only plant, as far as I am informed, in this country where they charge iron oxide back into the process when they manufacture sulphuric acid and iron oxide from a waste liquor is the one of the Titanium Pigment Company. It is a very large installation and it is said to be operating very efficiently. It was quite an expensive plant to install and would require large quantities of waste pickle liquor to warrant considering it. The present plant is processing a leach liquor which contains free sulphuric acid and iron sulphate, similar to waste pickle liquor, but the free sulphuric acid runs from 18% to 25% and iron sulphate 10% to 16%. In other words, it would almost pay to recover the free acid there if you had to haul the iron sulphate to the ocean and dump it, that is if you recovered the 20% of sulphuric acid, but they also transform the ferrous sulphate into sulphuric acid.

Waste liquor from steel mills may contain from about 1% to 7% of free acid. One of the pickle liquors we have analyzed contained 6.9% free acid. That is quite different from 20% acid in the waste liquor, hence one would have to make his chemical and engineering calculations on a different quality raw material. It may be where there is a sufficient quantity of spent pickle liquor in a given district, that all the steel companies could ship the liquor, copperas or monohydrate to a central "community" sulphuric acid plant and each participating steel company would receive credit toward the purchase of new concentrated sulphuric acid in proportion to the quantity and composition of the waste pickle liquor or iron sulphate shipped to the acid plant. Certain chemical companies are working on this proposition, too, with the idea of cooperating with the iron and steel industries if the plan appears advisable, and thus avoid construction of unnecessary sulphuric acid plants. One difficulty we have encountered is to secure sufficient accurate data, chemical and engineering, on pilot plants for the different processes, so we can really base reliable engineering calculations on them for comparative evaluation purposes.

In this country at least four processes are just in the pilot plant stage of development. Apparently the only ones other than the standard copperas process, that have gone clear through to production on a large scale are the "Chemico" and the Mantius, which operate on acidic leach liquors; and on a smaller scale the Butter-Little and Ferron processes operating on waste pickle liquor. In the "Chemico" and Mantius-Leonard-Monsanto processes sufficient pyrites can be mixed with the ferrous sulphate monohydrate to make up the additional sulphuric acid lost in the pickling operation. In that way, the roasting of the material is facilitated.

Mr. Holmes: What has been done for muriatic acid waste recovery?

Mr. Hodge: Not very much has been accomplished on that problem, although there are a number of processes which have been patented. Some claim the muriatic waste liquor is better for making iron oxide paint pigments than the sulphate liquor, producing brighter colors. In fact, some of the waste sulphate pickle liquors nowadays contain inhibitors which are said to impart dull shades to iron oxide pigments. There are the Parker, Stich, and Fireman processes for manufacture of paint pigments from waste pickle liquor. I have talked with some of the companies about the recovery of ferric chloride, ($FeCl_3$), from the waste muriatic liquors. There is a small demand, about 9,000 tons, per year, for that compound, but it seems that no very good process is available for recovering the iron chloride from spent pickle liquor. Most of the research on waste muriatic pickle liquor appears to have been along these two lines, but the results to date are not very satisfactory.

Mr. Babcock: Is this chlorine functioning only as an oxidizer, or is it necessary to have the chlorine in there? I was thinking we might be able to use electrolytic oxidation.

Mr. Hodge: One reason they like to use chlorine is that a good many state health officers often recommend chlorinating the sewage, anyway, so as to reduce the bacterial count of the effluent and abate obnoxious odors. By chlorinating the solution of copperas they not only oxidize part of it to ferric sulphate, but also have residual chlorine in the solution which kills micro-organisms. As far as electrolytic oxidation is concerned, it could probably be developed.

Mr. Voightlander: You spoke of the spent liquor having about 3% free acid. Is that general for the whole country, wherever sulphuric acid is used? Have you any figures on whether spent liquor for wire mills goes lower or higher than that?

Mr. Hodge: We have had some figures showing about 1% free acid. I think on the average, it would probably be around 1% to 2% free acid in batch pickling and it would be high in iron sulphate because in wire pickling the time, concentration, and other factors are more readily controlled by the operator. We have had some samples of the waste pickle liquors sent in from continuous strip pickling, and they have run from 3½% to 7% free acid. So, in my calculations, I took the average as 3% of free acid and 15% of iron sulphate.

Some analyses sent to me by one steel

company had as high as 30% of iron sulphate content and less than 1% of free acid. That is killing the pickling solution down pretty well, perhaps below the economically best practice, if the required time factor is considered.

Another matter which I took up in a discussion at a meeting of the Association of Iron and Steel Engineers at the William Penn Hotel in Pittsburgh last year, was a study of the pickling operation itself. It was found at some plants, by determining an overall sulphate balance on the pickling operation, that they were not really using in cleaning the steel much more than one-half the acid which was consumed. So they went to work in at least four plants, which I know about, and the engineers and chemists at those steel plants have informed me that they have greatly improved their pickling operations, reduced the amount of waste pickle liquor, of acid in the wash water, and are saving on total acid consumed.

An official of one company told me they were saving a tank car of acid every four weeks over what they used to consume, are doing just as much pickling; and as good a job. The improvements and savings have been accomplished as a result of making an intensive study of the pickling operations.

That is one way of reducing the amount of waste pickle liquor going into the streams; by saving as much acid as you can at the source.

Another company, which has followed that suggestion, found their pickling tanks had a lot of leaks in them. They were losing 15% to 20% of the acid through these leaks. That acid seeped gradually through the soil and got into the streams and wells.

The two problems, it appears to me, should be studied together; the pickling operation and the disposal of the waste. You have to consider that it may soon become necessary to treat that waste, hence it is not only the cost of pickling, but also you must add the cost of disposal of the waste pickle liquor; just as you must have an item of cost for disposal of blast furnace slag.

If the laws get too stringent, it may be that the steel companies will have to add another regular manufacturing cost item, after determining which is the best and most economical method or process for disposal of the spent pickle liquor for the particular locations involved.

Chairman Beeson: What is going to happen to the Monongahela River with regard to waste?

Mr. Hodge: I am not worrying much about the old Monongahela. I worked on that river for about fifteen years before I started on this problem. In 1923 I made the first stream pollution survey in the state of a part of the Monongahela River. If we seal all the abandoned mines in West Virginia—and it is reported that West Virginia leads the whole country in percentage of abandoned mines sealed—there will still be plenty of sulphuric acid and iron sulphate from the active coal mines, which cannot be sealed, to keep the sewage and organic wastes fairly well coagulated. But we can still reduce the acid load on the river quite a little by sealing more abandoned coal mines and by abatement of the waste pickle liquor discharged into it. Officials and chemists of several water companies which pump their water supplies from the Monongahela River have told me the quality of the river water has been much improved since the mine sealing operations have made considerable progress, and stored water from the Government's Tygart River Dam is allowed to increase the river flow during the summer months.

The Army Engineers and some other experts made an extensive survey some years ago on the acid load of the Ohio River in the Pittsburgh district. They estimated it as equivalent to around 3,000,000 tons of concentrated sulphuric acid per year, according to a recent report that heavy acid load has already been reduced 400,000 to 500,000 tons per year through sealing abandoned coal mines. In a previous report it was estimated that only about 10% to 20% of the acid load came from the iron and steel, paper and pulp, oil refineries, and other manufacturing industries — that around 85% of the acid load in the Pittsburgh district came from coal mines and probably more than half of it from abandoned mines. The acid load can be further reduced if funds are made available for continuation of mine sealing and maintenance on the mines already sealed.

I have talked with several men in West Virginia and some in Pittsburgh, who have been fishing on certain streams where the abandoned mines on the watershed had practically all been sealed and not many active mines were in operation. They reported catching fish where they had not seen fish for 20 to 25 years. The sealing of abandoned coal mines appears to be one of the cheapest ways for reducing acid loads on streams and is something everybody should be interested in. It does not interfere with the operation of active mines, in fact, it benefits industry as well as the water supplies of thousands of people and many municipalities. We can not clean up everything at once. It is only by doing what we can, as fast as we can, that we progress in the abatement of pollution.

Mr. Holmes: What do you consider the best method for treating the rinse water having just a nominal amount of iron and acid in it. Before discharging it into the stream?

Mr. Hodge: The disposal of rinse waters is a problem which has come up, to some extent, in this country, and more extensively in Germany especially in the Ruhr district. I think the cheapest treatment for pickling rinse waters is probably neutralization with lime or limestone. If you have in the district glass plants or Kraft process pulp mills that use sodium sulphate, neutralization of waste pickle liquor and rinse waters with soda ash might be satisfactory, provided there is waste heat to evaporate the solution and so recover the sodium sulphate. If you do not have waste heat available the costs for recovering the sodium sulphate would probably be too high to warrant installing a soda ash process.

Another factor that the iron and steel men should note carefully — if the spent pickle liquors are kept separate from the rinse waters, the average stream has what we call a certain natural alkalinity, or assimilability, that will take care of a considerable load of rinse waters and not pass the acid point.

I have talked with the sanitary engineers of the U. S. Public Health Service and of the State Health Departments of Pennsylvania, Ohio, and West Virginia, and they all tell me about the assimilability of the streams and the bad effects resulting from overloading a stream with sewage or industrial wastes. Also, in a good many steel plants you have certain alkalis. These might be discharged in a graduated flow with the acid wastes. You can make arrangements quite often with the health authorities to discharge neutral mixed wastes into the city sewers. I have found four such arrangements. The last one was in a steel plant near Los Angeles. Large volumes of cooling water and some alkaline liquor wastes from the steel mill are run into a big storage pond. The waste pickle liquor goes into a concrete tank nearby. They had some orifice outlets from the pickle liquor tank, and fed the waste pickle liquor into the effluent from the pond in proportion to the flow of the cooling waters and alkaline wastes from the plant. By so doing they are producing a mixed effluent which the State and Municipal officials allow the company to discharge into the city sewerage system, and it has not interfered with the operation of the plant. Before they made this arrangement, they used to dump the waste pickle liquor in large batches all at one time into the sewer and it seriously interfered with the proper operation of the city sewerage system. The arrangement is working out satisfactorily to the city and one of its own large industries, the steel company. There usually is a certain assimilability of sewage and of streams, and we all know the sewage is quite alkaline, especially on Mondays, when all the family clothes washing is done.

Chairman Beeson: It seems the best way for a mill in the smaller town is to work with the public officials.

Mr. Hodge: That plan has proved mutually advantageous in several cases. We should have started on this problem about ten years ago and been ready with well developed methods for utilizing chlorinated copperas, spent pickle liquor, or ferric sulphate in sewage treatment and water purification, when the big construction program for such plants started about five years ago, as a result of grants in aid and loans from the Federal Government. There has been more progress, backed by government money, made in sewage treatment and abatement of other forms of stream pollution during the last six years than in the preceding twenty years. If we had been ready for this development it is quite probable that several more large sewage disposal and water purification plants might be now utilizing copperas or waste pickle liquor in addition to the fifteen or twenty that do use chlorinated iron salts.

Mr. Holmes: How much iron or how much acid in the sewage can a straight sewage plant take care of, that is, an Imhoff tank?

Mr. Hodge: That type cannot take care of very much acid-iron waste. You must have properly designed preliminary treatment at the steel plant. Likewise if you run the waste pickle liquor in sudden large quantities directly into an activated sludge process, it is said to plug up the diffuser plates and cause

other serious operation difficulties. Somewhat over a year ago I attended a conference held in the offices of the Chicago Sanitary District. They were having trouble treating the sewage and thought the difficulties were caused by waste pickle liquors from the South Chicago and Gary districts. The engineers of the Sanitary District and steel companies were working out a cooperative plan of experimental work to determine definitely if the waste pickle liquor was causing the difficulties, and if so, what preliminary treatment at the steel plant would be necessary in order to permit continuance of discharge into the sewers.

Another thing you have to be careful about in all this work, as you men know, is not to jump at conclusions. The fact that they can use chlorinated waste pickle liquor in Akron, Ohio for water purification is no sure sign they can use it in some other city having a very different quality of raw water supply. Chlorinated copperas is giving satisfactory results in the treatment of sewage in Birmingham, Alabama, Coney Island, N. Y., El Paso, Texas, and in several other plants (4-a, 4-b and 4-c). Whether it would work as well on a sewage from a highly industrialized district would have to be determined. You have to make experiments and so determine the best system for each particular location.

Sewage will carry a moderate load of iron, and the average sewage is quite alkaline and will take quite a little free acid, if it does not come in sudden large quantities which produce critical conditions in the sewerage system, or sewage disposal plants.

But it is quite like some of the fish killings. The industries have been to blame, to some extent, for their own unfavorable publicity. They dump a whole lot of waste pickle liquor, or acid waste from a sulphite pulp mill all at once into a stream during a period of low flow. It just kills the fish for miles downstream. That is what happened in one case that I observed. Then all the newspaper men came up with cameras and took pictures of the thousands of dead fish lying on the river banks and floating down the stream. That industry had a lot of public relations work to do for the next couple of years. It was largely their own fault. That stream would have carried a fair amount of acid if it had been fed in gradually and the whole batch of waste could have been disposed of especially if they had waited for a period of high flow in the river. That is one thing to look out for. Do not produce "shock" or critical conditions in streams or sewerage systems. It is better to work with the state public health officials and municipal authorities. Often mutually advantageous arrangements can be made. I believe many of the public officials are adopting a more cooperative attitude toward industry and the industries would be wise to reciprocate on cooperative proposals. The Federal government has recently inaugurated a three year "Pollution Survey of the Ohio River" and its tributaries, with headquarters at Cincinnati. Sanitary engineers on this survey have kindly interviewed me at the Mellon Institute, and it is evident that the Government has planned a thorough and constructive study of the sewage and industrial wastes disposal problems of the Ohio River Basin.

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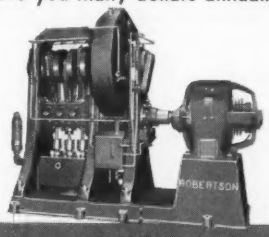

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Outstanding Personalities of the Wire Industry

William Dickson Pierson

WILLIAM DICKSON PIERSON, Secretary and Director of the Waterbury Farrel Foundry & Machine Company of Waterbury, Connecticut, died at his home in that city December 2nd, aged 67 years. Mr. Pierson was born in Orange, New Jersey and was graduated from Stevens Institute of Technology in 1894. He joined the engineering staff of the Waterbury Farrel Foundry & Machine Company in 1895, thus having completed nearly 45 years continuous service with that company.

✦ ✦ ✦

AN engineer and machine designer of the first rank, Mr. Pierson was well-known and highly regarded, particularly in the wire drawing machine field. He was a director of the National Wire Machine Builders Association and a member of the Tau Beta Pi, honorary engineering fraternity.

✦ ✦ ✦

MR. PIERSON was one of the founders and original Directors of the Wire Association and his advice and assistance in conducting the affairs of the Association in its early days not only were most helpful but pointed the way to many of the activities the Association is now conducting.

✦ ✦ ✦

IT is with great regret that the Board of Directors of the Wire Association extends to the family and relatives of Mr. Pierson their condolences and sympathy at this time.

✦ ✦ ✦

WE will always remember "Bill" for his helpfulness, friendliness and courtesy as well as for his great assistance in the work of the Association.

HOYT SHEPARD
Asst. to General Sales Manager
Continental Steel Corp.

Continental Steel Announces Changes

ANNOUNCEMENT has been made by **Edmond P. Severns**, vice-president in charge of sales for the Continental Steel Corporation, Kokomo, Indiana, of the following appointments in the sheet division of the company:

✦ ✦ ✦

JOHN F. McCOMB, since September, 1937, assistant sales manager of the wire division, has been named sales manager of the Merchants Trade Sheet Division for the company's Kokomo and Indianapolis plants.

✦ ✦ ✦

A. C. HUBER, since July, 1931, assistant sales manager of the Manufacturers' Sheet Division, has been appointed Sales Manager of the Manufacturers' Sheet Division, for the company's Kokomo and Indianapolis plants.

✦ ✦ ✦

HOYT SHEPARD, since 1930 assistant sales manager of the Sheet Division, has been named assistant to the general sales manager.

MR. McCOMB has been identified with Continental since May, 1928, being sales manager of the Ornamental and Chain Link divisions until April, 1934. At that time, he was named sales manager of the Eastern Division of the company. He was named assistant sales manager of the wire division in September, 1937. Prior to his connection with Continental, he was with Capper Publications.

✦ ✦ ✦

MR. HUBER who has been engaged in the sheet steel industry for 32 years, started with Continental in July, 1931, as assistant sales manager of the Manufacturers' Sheet Division. His previous connections were with the Stark Rolling Mill Company, Canton, Ohio, which later became the United Alloy Steel Corporation and with the Allan Wood Iron & Steel Company, Philadelphia, Pennsylvania.

✦ ✦ ✦

MR. SHEPARD'S connection with the organization began in 1921 with the Chapman-Price Steel Company, a subsidiary of the Continental Steel Corporation since 1927. In 1930, he was named assistant sales manager of the sheet division of the Kokomo and Indianapolis plants.

✦ ✦ ✦

MR. IRWIN started his career in the steel industry with the Canton Sheet Steel Company, Canton, Ohio. In 1921, he entered the production department of The Superior Sheet Steel Company, Canton, Ohio, a Continental subsidiary since 1927. He served as assistant sales manager of this concern until 1934, when he became sales manager. He continues in this capacity with the organization.

✦ ✦ ✦

British Purchasing Commission

MR. ARTHUR B. PURVIS, Director-General of the British Purchasing Commission, 25 Broadway, New York, announces the following appointments to the Commission: Director of Purchases, Mr. Edgar S. Bloom; Director of Administration, Mr. F. Johnson.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Oct. 1939 and Oct. 1938
(In gross tons)

	OCT. 1939	SEPT. 1939	OCT. 1938
Wire rods	2,779	1,829	1,232
Strip steel	10,253	6,852	6,121
Plain, black or galvanized iron or steel wire	5,271	4,707	5,124
Barbed wire and woven wire fencing	7,167	5,473	4,417
Woven wire screen cloth	252	121	124
Wire rope	741	399	235
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	1,140	842	428
Wire nails	2,720	1,482	2,040
Tacks	37	20	36
Other nails, including staples	586	352	351
Bolts, machine screws, nuts, rivets and washers	814	757	674
Totals, these 11 classifications	31,760	22,834	20,782

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete Reinforcement bars	.....	20	86
Hollow bar and drill steel	107	107	79
Wire rods	1,152	1,052	415
Barbed wire	100	1,159	973
Round iron and steel wire	286	185	199
Telephone and telegraph wire	.....	.....	2
Flat wire and strip steel	273	202	243
Wire rope and strand	54	74	162
Other wire	18	109	114
Hoops and bands	185	1,276	1,079
Nails, tacks and staples	73	549	414
Bolts, nuts and rivets	10	7	30
Total, these 12 classifications	2,258	4,746	3,796

Exports of Insulated Wire and Cable, October 1939

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber-covered wire	550,312	$114,593	195,941	$ 32,404
Weatherproof wire	237,915	44,595	102,959	15,729
Other insulated copper wire	744,480	154,681	183,039	28,718
Nickel-chrome electric resistance wire	38,751	41,160	15,254	4,648
Total, these 4 classifications	1,571,458	$355,029	497,192	$ 81,499

October Exports Rise Slightly — Imports Drop Sharply

EXPORTS of iron and steel from the United States were slightly increased at 255,081 gross tons valued at $16,835,795 in October. This was a gain of about 4 percent in quantity and of 8.75 percent in value over the 244,933-ton, $15,481,546 trade of September, and topped the 201,473-ton, $11,463,580 trade of October 1938 by a wide margin.

✦ ✦ ✦

TEN months exports—1,772,069 tons valued at $116,555,474—trail those of the comparable period of 1938—1,786,660 tons valued at $128,104,620—by 0.8 and 0.9 percent, respectively.

✦ ✦ ✦

Shipments to Europe Increase

DESPITE the relatively slight increase reported in the total October export trade there was interesting shifts in the trade with Continental areas. Shipments to Europe, chiefly because of a marked gain the trade with the United Kingdom, rose from 51,879 tons in September to 74,632 tons in October, while there was a roughly corresponding decline in the trade with the Far East—to 49,607 tons from September's 69,743 tons. The trade with North and Central America and the West Indies increased only very slightly—from 78,155 tons to 78,628 tons, but the trade with South America climbed to 39,936 tons from 34,846 tons, and that with Africa rose to 12,278 tons from 10,310 tons.

✦ ✦ ✦

Imports Sharply Reduced

IMPORTS of iron and steel products into the United States in October were little more than three-fifths as large as in September. Only 16,884 gross tons of these products valued at $1,147,656 were brought into the United States during the month against 26,658 tons valued at $1,431,318 in September and the 20,921 tons valued at $1,300,714 reported received in October 1938.

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RECEIPTS from belligerent countries were sharply reduced—France being credited with only 4 tons in October against 1,782 tons in September, Germany with 129 tons against 1,103 tons, and the United Kingdom, never a large supplier, with 63 tons against a September total of 86 tons. The trade with Belgium-Luxemburg and that with Norway was also sharply cut—the former to 1,032 tons from 5,371 tons in the month preceding and that of the latter to 1,779 tons from 3,674 tons. On the other hand imports from the Netherlands rose from 11 tons in September to 1,402 tons in October, those from Sweden climbed to 2,979 tons from 1,918 tons, while the participation of British India increased from 2,700 tons to 4,132 tons.

✦ ✦ ✦

Scrap Exports Up Slightly

EXPORTS of scrap from the United States in October—336,775 tons valued at $16,835,795—were slightly greater than the 330,680-ton, $15,481,546 trade of September. A year ago—in October 1938—this trade amounted to 223,954 tons valued at $3,238,232.

✦ ✦ ✦

CUMULATIVE exports for the 10 months period ended with October stand at 3,098,367 tons valued at $46,572,685. During the corresponding period of 1938 2,401,793 tons of scrap valued at $37,034,379 had been dispatched to foreign buyers.

✦ ✦ ✦

Canada Leading Buyer

IN October, Canada again lead all countries in the purchase of iron and steel products from the United States. A total of 53,137 tons was shipped to that country including 14,033 tons of skelp, 7,773 tons of non-alloy "black" steel

(*Please turn to Page 71*)

The Wire Association Registered Attendance At Annual Meeting, Chicago, Ill., October 23-27 1939

ADAMS, C. S., Mech. Designer,
Amer. Smelting & Refining Co.,
Indianapolis Ave., Whiting, Indiana.

BOSWIN, GEORGE A., Sales Mgr.,
Reel Dept.,
Stevens Metals Products Co.,
Niles, Ohio.

BOUVIER, GEO. A., Dev. Engineer,
General Cable Corporation,
Perth Amboy, New Jersey.

BRALEY, DR. S. A.,
Pittsburgh Steel Company,
Pittsburgh, Pa.

BROADDUS, E. T., Salesman,
Firth-Sterling Steel Co.,
Kansas City, Mo.

BRODEN, G. A., President,
Broden Construction Co.,
Cleveland, Ohio.

BRONSON, W. D., Salesman,
Carboloy Company, Inc.,
Chicago, Illinois.

BROTEN, O. A., Vice President,
National Pneumatic Co.,
Rahway, N. J.

BROWN, HUGH A., Dir. of Res.,
W. S. Tyler Company,
Cleveland, Ohio.

BROWN, RICHARD E., Publisher,
WIRE & WIRE PRODUCTS,
Stamford Trust Co. Bldg., Stamford, Conn.

BROWN, WM. L., President,
Detroit Wire Die Company,
17360 Lahser Avenue,
Detroit, Michigan.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues are $10.00

✦ ✦ ✦

The 1940 Convention will be held in October at Cleveland, O.

✦ ✦ ✦

For Details Address

Richard E. Brown, Secretary
The Wire Association
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Stamford Trust Co. Bldg.

BUCHANAN, D. D., Mgr. of Operations,
Union Drawn Steel,
Div. of Republic Steel Corp.,
Massillon, Ohio.

CALLAGHAN, JOHN C., Works Manager,
Canada Works, Steel Co. of Canada, Ltd.,
Hamilton, Ontario, Canada.

CARL, A. F., Salesman,
Cleveland Tramrail Div. of
Cleveland Crane & Engr. Co.,
Wickliffe, Ohio.

CARPENTER, C. H., Chief Engr.,
Lee Wilson Sales Corporation,
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1317 Arcade Bldg., St. Louis, Mo.

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Cleveland Tramrail Division of the
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National Lock Washer Co.,
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Metallurgical Development,
Anaconda Wire & Cable Co.,
Hastings-On-Hudson, N. Y.

BAWDEN, WILLIAM D., Gen. Supt.,
Reynolds Wire Company,
Dixon, Illinois.

BEAMAN, P. ALDEN, Sales Manager,
Wire Machinery Department,
Morgan Construction Co.,
Worcester, Mass.

BEARDSLEE, K. R., General Sales Manager,
Carboloy Company, Inc.,
Detroit, Mich.

BEESON, J. K., Asst. Gen. Sales Mgr.,
Pittsburgh Steel Co.,
Pittsburgh, Pa.

BLETSO, BRUCE N., Engineer,
American Steel & Wire Co.,
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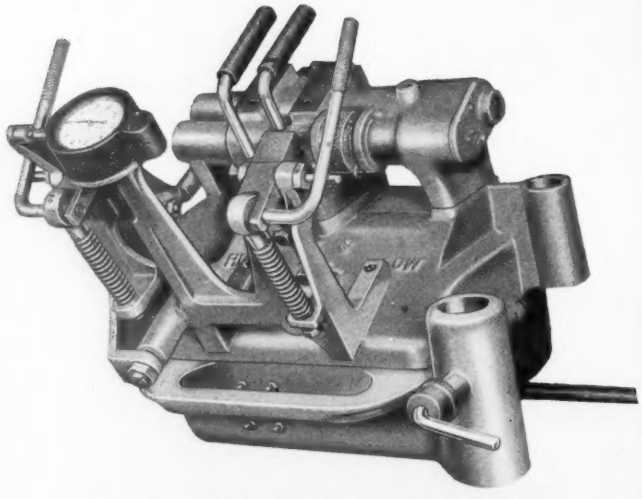

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CLARK, E. W., Mechanical Engineer,
Wire & Cable Section,
General Electric Company,
Schenectady, N. Y.

CLARK, HERBERT B., Sales Mgr.,
Vascoloy-Ramet Corporation,
North Chicago, Illinois.

CLARK, T. L., Major, Sig. Corps,
Signal Supply Officer,
Chicago, Illinois.

CLEMENTS, W. C., Asst. Met. Engr.,
Bethlehem Steel Company,
1730 Cloverleaf Street,
Chicago, Illinois.

CLIFFORD, RALPH K., V. P. Chg. Oprs.,
Continental Steel Corp.,
Kokomo, Ind.

COCHRAN, I. G., Supt. Wire Mill,
Laclede Steel Co.,
Alton, Ill.

CORDER, HENRY, G., Foreman,
Keystone Steel & Wire Co.,
Peoria, Illinois.

CRANE, C. C., Metallurgist,
Wire Div., Republic Steel Corp.,
7850 So. Chicago Ave., Chicago, Ill.

CRAMER, R. E., Dist. Engr.,
American Steel & Wire Co.,
830 Frick Bldg.,
Pittsburgh, Pa.

CRAWFORD, W. H.,
Eaton Mfg. Co.,
Massillon, Ohio.

DeLAMATTER, WM. W., Metallurgical Engr.,
American Steel & Wire Co.,
Cleveland, Ohio.

DesCOMBES, L. E.,
International Harvester Co.,
Wire & Spring Plant,
Springfield, Ohio.

DIMLING, PAUL E., Salesman,
Firth-Sterling Steel Co.,
Cleveland, Ohio.

DOBERSTEIN, EDWARD P., Engr.,
Goodman Mfg. Company,
Chicago, Illinois.

DONACHIE, MATTHEW J., Engr.,
Geo. W. Prentiss Co.,
Holyoke, Mass.

DOVE, ALLAN B., Engr.,
The Steel Co. of Canada, Ltd.,
Montreal, Canada.

DRIVER, WALTER, Engineer,
South African Iron & Steel
Indust. Corporation, Ltd.,
Pretoria, South Africa.

DUNKELBERGER, L. E., Gen. Mgr.,
Reynolds Wire Co.,
Dixon, Ill.

EASTLAKE, WM. H., Works Mgr.,
Cable Division,
Northern Electric Co., Ltd.,
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ELDER, FLINT C., Dir. of Research,
American Steel & Wire Co.,
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ELIAS, H. W., Assistant Manager,
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Flushing, L. I., N. Y.

ESPOSITO, RALPH, Salesman,
Vascoloy-Ramet Corporation,
Century Building,
Pittsburgh, Pa.

EVERLING, W. O., Asst. Dir. of Research,
American Steel & Wire Co.,
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FAIRBROTHER, W. D., Factory Mgr.,
Wallace Barnes Co., Ltd.,
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FANTONE, C. B., President,
Syncro Machine Co.,
420 Lexington Ave., New York, N. Y.

FARNSWORTH, W. B., Chief Metallurgist,
Pittsburgh Steel Co., Monessen, Pa.

FAST, PAUL R., Plant Supt.,
Belden Manufacturing Co.,
4625 W. Van Buren St., Chicago, Ill.

FISHER, E. J. P., Mgr.,
Wire Drawing Machy. Div.,
Aetna-Standard Engineering Co.,
Youngstown, Ohio.

FRASER, JAMES A., Asst. Sales Mgr.,
Vascoloy-Ramet Corporation,
North Chicago, Illinois.

FRASER, J. H., Gen. Supt.,
Dominion Steel & Coal Co.,
Sydney, Nova Scotia.

GALLOWAY, JAMES W., Plant Engineer,
B. Greening Wire Co., Ltd.,
Hamilton, Ontario, Canada.

GIBBONS, J. P., Elec., Engr.,
Goodman Mfg. Co.,
4834 S. Halsted Street,
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(Please turn to Page 68)

EASE UP
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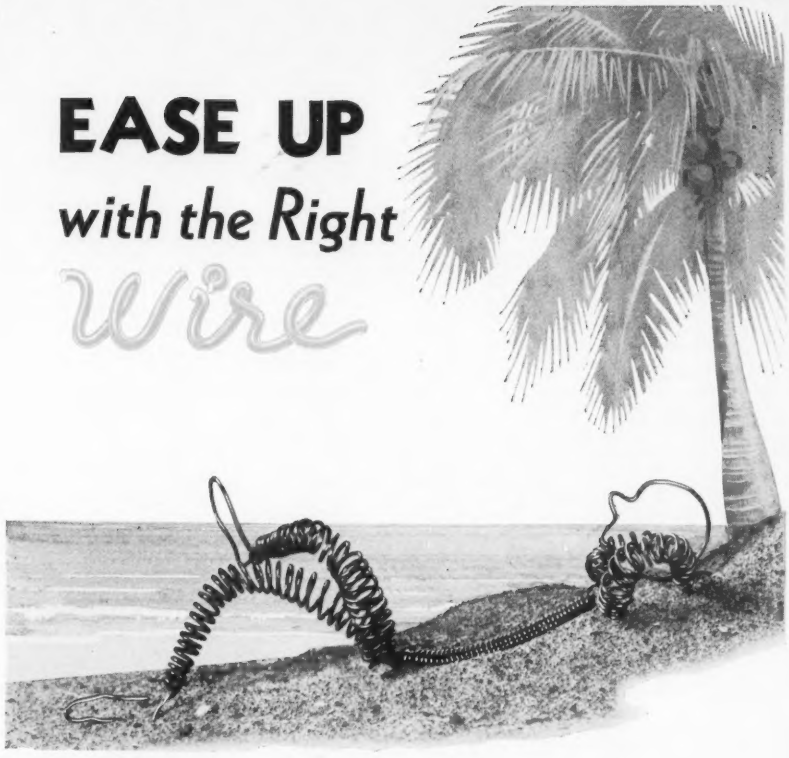

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(Continued from Page 67)

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GLADER, FRANK J., President, Wm. Glader Machine Works, 210 N. Racine Avenue, Chicago, Illinois.

GLEN, A. E., Salesman, Carboloy Co., Inc., 704 2nd Ave., Pittsburgh, Pa.

GRAFF, HOWARD F., Res. Met., Universal-Cyclops Steel Corp., Bridgeville, Pa.

GRAHAM, WALTER H., Service Dept., Submerged Combustion Co. of America, Hammond, Indiana.

GRANGER, L. D., Assistant to Vice President, Wickwire Spencer Steel Co., 500 Fifth Ave., New York, N. Y.

GRASSELL, P. W., Pres., Wilson Steel & Wire Co., 4840 S. Western Ave., Chicago, Ill.

GRAY, THEO. H., Res. Engr., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GREAVES, R. K., Ekstrand & Tholand, Detroit, Michigan.

GUNDSTROM, E. W., Asst. Plant Manager, Rome Cable Corp., Rome, N. Y

HAAG, L. W., Representative, Nukem Products Corporation, Buffalo, New York.

HAARBAUER, H. W., Supt. Wire Mill, Townsend Company, New Brighton, Pa.

HAKA, JOHN E., Works Manager, Midland Wire Corp., Tiffin, Ohio.

HALL, E. P., Metallurgist, Kennecott Wire & Cable Co., Phillipsdale, R. I.

HAMAKER, R. L., Dist. Sales Mgr., Warner Company, 122 E. 42nd Street, New York, N. Y.

HAMMERSTEIN, H. K., Chem. Engr., Broderick & Bascom Rope Co., 4203 N. Union Blvd., St. Louis, Mo.

HANGER, F. M., Plant Supt., Wilson Steel & Wire Co., 4840 S. Western Avenue, Chicago, Ill.

HANNON, C. H., Metallurgist, General Electric Company, Pittsfield, Mass.

HARRIS, W. F., Salesman, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

HARRISON, C. E., Asst. Sales Mgr., Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

HARRISON, N. C., Vice President, Atlantic Steel Company, Atlanta, Ga.

HESSDOERFER, GEO. M., Sales Engr., Lewis Machine Company, Cleveland, Ohio.

HILL, H. W., Asst. Gen. Supt., Northwestern Steel & Wire Co., Sterling, Ill.

HJELM, ART., Foreman, Wilson Steel & Wire Co., 4840 S. Western Avenue, Chicago, Ill.

HODGES, W. W., Research Fellow, American Iron & Steel Institute, Mellon Institute, Pittsburgh, Pa.

HOLMES, A. W., Engineer, Indiana Steel & Wire Co., Muncie, Indiana.

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HUBBARD, E. F., President, Hubbard Spool Company, 1622 Carroll Avenue, Chicago, Ill.

HUBBARD, E. J., JR., Vice Pres., Hubbard Spool Company, 1622 Carroll Avenue, Chicago, Ill.

HUBBARD, L. A., Secy.-Treas., Hubbard Spool Company, 1622 Carroll Avenue, Chicago, Ill.

HUGHES, CHARLES E., Sales Engineer, Firth-Sterling Steel Co., McKeesport, Pa.

HUSSEY, R. M., Supt. Wire Dept., Jones & Laughlin Steel Corp., Aliquippa, Pa.

INGHAM, T. S., Asst. Sales Mgr., American Chemical Paint Co., Ambler, Pa.

JACKMAN, ALAN, Salesman, Firth-Sterling Steel Co., 710 W. Lake St., Chicago, Ill.

JANSEEN, MARTIN L., Foreman, Russell-Burdsall-Ward Bolt & Nut Co., Rock Falls, Illinois.

JENSEN, C. L., Chicago, Rep., The Ironsides Company, Columbus, Ohio.

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JOHNSTON, ROBT. S., Dir. Research, John A. Roebling's Sons Company, Trenton, New Jersey.

JUDY, PAUL, Chemist, Indiana Steel & Wire Co., Muncie, Indiana.

KAUFMAN, C. W., Asst. Supt. Wire Mill, Continental Steel Corporation, Kokomo, Indiana.

KELLOGG, C. A., Ch. Metallurgist, Continental Steel Corporation, Kokomo, Indiana.

KENT, M. A., Vice-President, General Cable Corp., New York, N. Y.

KENYON, H. G., General Electric Co., Pittsfield, Mass.

KIESS, CLYDE G., Engineer, National Rubber Machinery Co., Akron, Ohio.

KINTER, C. W., Amer. Rep., International Construction Co., Ltd., Westfield, New York.

KLEIN, H. C., Sales Engineer, B. F. Goodrich, Co., Akron, Ohio.

KNOX, J. D., Assoc. Editor, Steel, Cleveland, Ohio.

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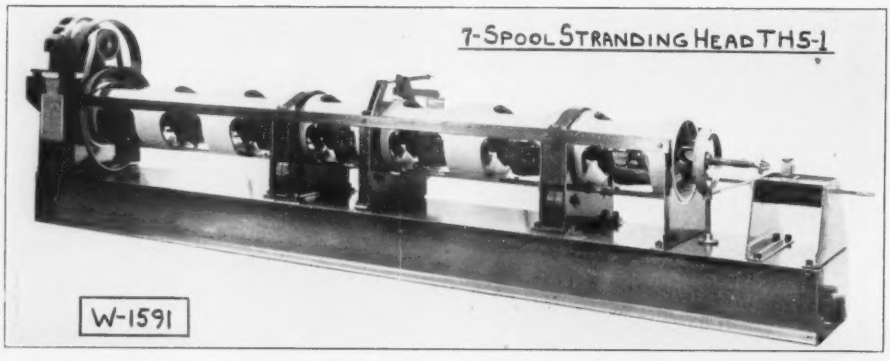

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Western Electric Company,
Kearny, New Jersey.
LONGENECKER, HARRY F., Sales,
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McCOY, F. A., Metallurgist,
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(Please turn to Page 62)

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(Continued from Page 69)

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SEBURN, WM. A., Superintendent Wire Mills,
Pittsburgh Steel Co., Monessen, Pa.

SEE, THEO. S., President,
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Hammond, Ind.

SEE, WALTER G., Sales & Service Mgr.,
Submerged Combustion Co. of America,
Hammond, Ind.

SELLEN, C. A., Metallurgist,
Eaton Reliance Mfg. Co.,
622 Cherry Road, N.E.,
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SEVERSON, JEL C., Chemist,
A. O. Smith Corporation,
Milwaukee, Wisconsin.

SEYMOUR, L. D., Asst. Works Mgr.,
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SHORT, CHARLES P., Salesman,
Steel Company of Canada, Ltd.,
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SIMMONS, R. S., Ch. Metallurgist,
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SMITH, H. H., Dist. Mgr.,
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SOLGER, W. H., Sales Engr.,
Wire Drawing Machy. Div.,
Aetna-Standard Engineering Co.,
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SOMERVILLE, W. E., Engineer,
W. E. Somerville & Co.,
Coal City, Ill.

SOMMER, LESTER B., Assistant to President,
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SPOWERS, W. H., Jr.,
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TIMBERLAKE, JOHN E.,
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TREMBOUR, F. N., Res. Engr.,
Westinghouse Elec. & Mfg. Co.,
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VAN VALKENBURG, F. S., Engr.,
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Rustless Iron & Steel Co.,
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WENTZ, CHARLES R., Ch. Insp.,
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WEYANT, R. K., Wire Mill Supt.,
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WHITNEY, L. C., Chief Metallurgist,
Copperweld Steel Co.,
Glassport, Pa.

WHYTE, R. B., General Superintendent,
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WIGGINS, C. R., Chief Metallurgist,
Northwestern Steel & Wire Co.,
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WILKINSON, THOMAS, Chic. Off. Mgr.,
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WILLIAMS, JACK P., Rep.,
Syncro Machine Co.,
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WITHINGTON, ROBERT W., President,
American Insulating Machinery Co.,
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WOODHEAD, H. R., Research Engineer,
John A. Manning Paper Co.,
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YOUNG, LAFE, General Superintendent,
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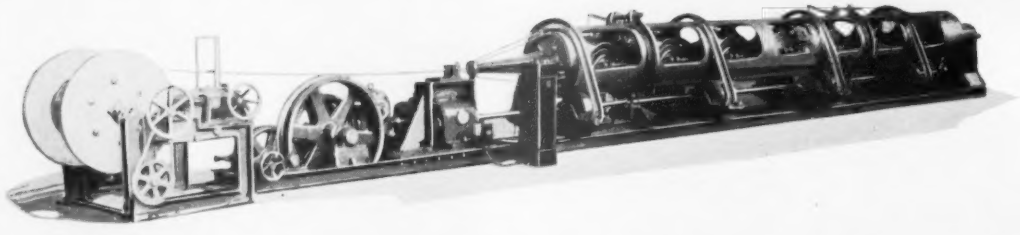
ZAPP, A. R., Manager Firthaloy Div.,
Firth-Sterling Steel Co.,
McKeesport, Pa.

Announcing the New 1940 Model National Tube Type Strander



THIS Strander is equipped with variable speed haul-off eliminating the use of change gears. With the new National Strander, changing lay lengths is but a matter of seconds.

✦ ✦ ✦

CHANGING from right lay to left lay requires only the shifting of clutch lever; electric brakes of latest type add much to the efficiency of operation.

✦ ✦ ✦

THIS Strander is equipped with ball-bearings throughout, has Textilite tube rollers and Carboloy wire guides, quick operating bobbin latches and bobbin brakes.

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Exports and Imports of Wire

(*Continued from Page 65*)

sheets, 6,338 tons of plain shapes, and 4,442 tons of non-alloy "other" plates. United Kingdom ranked second with pig iron, 39,354 tons, and non-alloy ingots, 5,013 tons accounting for the bulk of the 46,037 tons taken. The main items purchased to make up Japan's 15,805-ton trade were non-alloy steel ingots, 7,612 tons, and alloy ingots 4,203 tons. The 13,724-ton trade with the Philippine Islands included many items with galvanized steel sheets, 2,381 tons, concrete reinforcement bars 1,477 tons, non-alloy "other" steel bars 1,187 tons, and wire nails 1,170 tons the most important.

✦ ✦ ✦

Scrap Exports Higher

SCRAP exports in October advanced to 336,775 tons valued at $5,730,606 from 330,680 tons valued at $5,100,069 shipped in September. Included in the October total were 334,664 tons of iron and steel scrap, 760 tons of tin plate scrap, 340 tons of tin plate circles, strips, etc., and 1,011 tons of waste-waste tin plate. Principal purchasers during October were Japan 248,936 tons, the United Kingdom 38,563 tons, and Canada 26,363 tons.

✦ ✦ ✦

Import Trade Lower

OCTOBER imports of iron and steel products dropped to 16,884 tons with pig iron—5,077 tons furnished by British India, 4,132 tons and Canada, 945 tons — the most important item in the trade. The 3,115 tons of ferromanganese came from Norway, 1,713 tons and the Netherlands, 1,402 tons; while Canada sent in the 2,364 tons of spiegeleisen.

✦ ✦ ✦

Wood Screws

EXPORTS of iron and steel wood screws during October, 1939, totaled 33,727 gross valued at $5,523. Of this total, Guatemala took 6,536 gross valued at $887; Ecuador, 5,050 gross valued at $912; Cuba, 4,586 gross valued at $559; Colombia, 3,768 gross valued at $850; Costa Rica, 3,251 gross valued at $430; Peru, 2,860 gross valued at $522; Mexico, 1,885 gross valued at $263; Venezuela, 1,365 gross valued at $275.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 5,932 gross valued at $2,333. Of this total Cuba took 1,200 gross valued at $408; Argentina, 1,200 gross valued at $408; Guatemala, 1,070 gross valued at $136; Mexico, 786 gross valued at $493; Canada, 609 gross valued at $296; Jamaica, 288 gross valued at $247; Colombia, 226 gross valued at $135.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 8,400 gross valued at $328, supplied by Japan, 5,000 gross valued at $100, and Belgium, 3,400 gross valued at $228.

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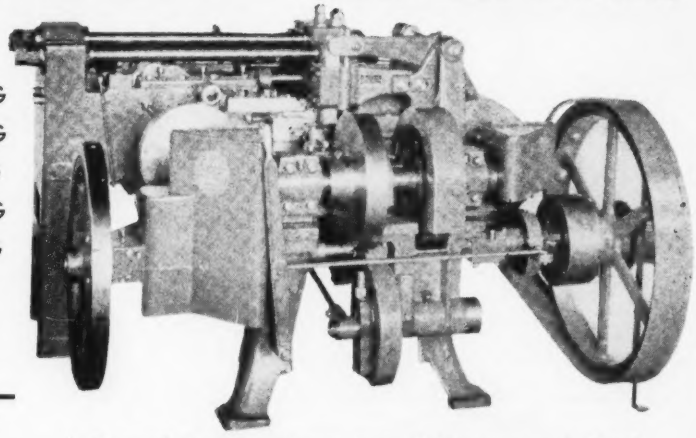

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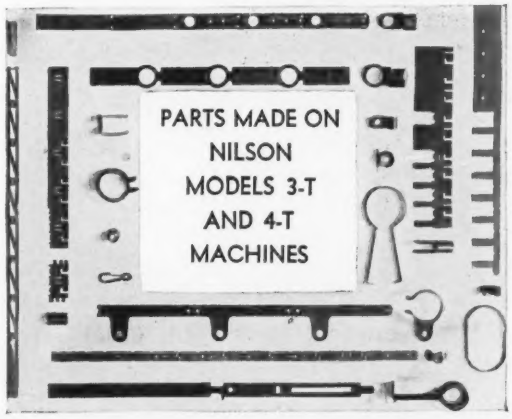

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A Review of Recent Wire Patents

No. 2,178,912, WIRE CLEANING DEVICE, Patented November 7, 1939 by Francis P. Leahey, Worcester, Mass., assignor to The American Steel and Wire Company of N. J., a corporation of N. J.

This device is said to be adapted to cleaning the oxide coating from wire formed in the wet wire-drawing process. The device adjusts itself relative to the wire as it passes therethrough.

✦ ✦ ✦

No. 2,179,296, FILAMENT COILING MACHINE, Patented November 7, 1939 by Fred B. Iden, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of N. Y.

According to the specification, this machine will produce wire filaments having straight end sections, which assist in mounting thereof, and is described as an improvement upon the machine disclosed in U. S. patent 1,771,927 of July 29, 1930.

✦ ✦ ✦

No. 2,179,304, CLOSER FOR WIRE ROPE OR STRANDING MACHINES, Patented November 7, 1939 by William E. Somerville, Coal City, Ill.

Electrically-controlled clutch mechanism is provided whereby the machine operator is enabled to render any one or more of the clutches inoperative and make it possible to connect the respective reel-carrying cradle with a suitable auxiliary driving mechanism, to rotate the cradle either way so as to place the particular strand in the position it should be placed with respect to the others.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

✦ ✦ ✦

No. 2,179,348, WIRE DRAWING MACHINERY, Patented November 7, 1939 by Gaylord W. Penney, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania.

A new forwarding drum is provided, particularly for tandem wire drawing machines, with increased drum surface and dissipation of heat from the wire.

✦ ✦ ✦

No. 2,179,389, COILING APPARATUS, Patented November 7, 1939 by Ralph R. Turner, Warwick, and Francis W. Sullivan, Cranston, R. I., assignors to United Wire & Supply Corporation, a corporation of Rhode Island.

Among the objects of this invention, is to provide a helical coiling apparatus which, when tripped, will perform one cycle of wire coiling and then stop for manual manipulation. There are 16 claims.

✦ ✦ ✦

No. 2,179,825, WIRE REEL SUPPORT, RACK OR STAND, Patented November 14, 1939 by Fred O. Lewis, Dayton, Ohio.

This rack is adapted to support standard reels of wire and is equipped with tensioning means which will co-act with the standard reel to maintain constant tension.

✦ ✦ ✦

No. 2,180,208, MACHINE FOR BANK-WINDING ELECTRICAL COILS, Patented November 14, 1939 by Frederick N. Jacob, Chicago, Ill., assignor to Johnson Laboratories, Inc., Chicago, Ill., a corporation of Illinois.

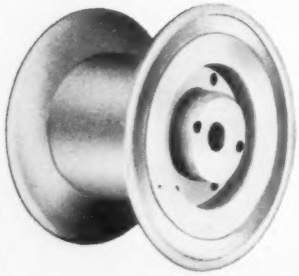
Cam mechanism is provided for imparting movement laterally and vertically to the device guiding the wire winding to the coil being wound, and also controls the making of the crossover between successive banks of the coil. There are 15 claims.

✦ ✦ ✦

No. 2,180,633, SCREW HEAD, Patented November 21, 1939 by Clarence G. Holdt, Melrose, Mass.

The head is provided with four radial grooves extending symmetrically from the central surface portion, each groove

FINE WIRE HIGH SPEED WIRE DRAWING SPOOLS



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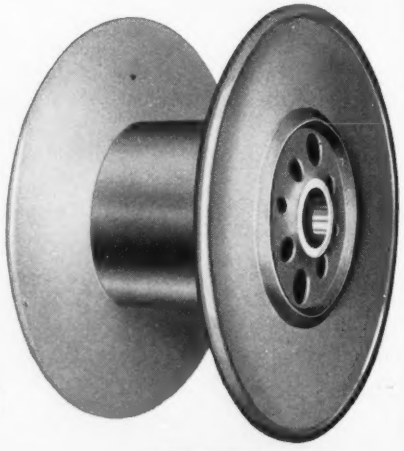


COMBINATION
500 lb. CAPACITY WIRE DRAWING — ANNEALING — STRANDING — REEL.

having parallel side walls and a straight bottom starting flush with the central surface portion and slipping radially outward and downward therefrom at an angle of more than 45° with the axis of the screw.

✦ ✦ ✦

No. 2,180,731, COMBINED POWER AND COMMUNICATION CABLE, Patented November 21, 1939 by Harry F. Dickinson, Yonkers, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

About the insulated inner wire conductors for transmitting modulated currents, there is an electric power transmitting circuit comprising outer power circuit wires to conduct alternating currents, and arranged to provide a zero electric field at the inner group of conductors and to prevent distortion of the current transmitted thereby.

✦ ✦ ✦

No. 2,181,084, ELECTRICAL CABLE, Patented November 21, 1939 by James Nelson Aken, Rome, N. Y., assignor to General Cable Corporation, New York, N. Y., a corporation of N. J.

For use in building wiring, this cable has heavy spiral strands of tough dense fibrous material braided about the wire conductor and a neutral stranded conductors of ribbon-like form spirally wrapped in a long lay directly over the fibrous material sheath, and insulated.

✦ ✦ ✦

No. 2,181,188, INSULATED CABLE, Patented November 28, 1939 by Archie R. Kemp, Westwood and Frank S. Malm, Millburn, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of N. Y.

This submarine cable comprises a highly conductive metal surrounded by a highly magnetic metal including as a pressure equalizing material surrounding the magnetic metal a viscous or semi-liquid substance consisting principally and as an essential constituent of polymerized mono-olefin hydrocarbons, and thermoplastic insulation surrounding the substance.

WANTED

Copies of Back Issues of

WIRE AND WIRE PRODUCTS

for

February, March, August,

November and December 1936.

January, February, April

and May 1937

WIRE AND WIRE PRODUCTS

300 Main St., Stamford, Conn.

✦ ✦ ✦

No. 2,181,341, WIRE ROPE, Patented November 28, 1939 by Eugene J. Reardon, East Haven, Conn., assignor to The American Steel and Wire Company of N. J., a corporation of N. J.

The inventor provides an 8 x 36 wire rope, having a 6 x 30 flattened strand wire rope for a core and which is characterized in that when it is tensioned the flattened strands of the core tend to rotate to cause their corner or edge porions to aid in radially supporting the wire rope strands.

✦ ✦ ✦

No. 2,181,475, CABLE, Patented November 28, 1939 by Pierre Marcel Bourdon, Paris, France, assignor to Michelin et Cie, Clermont-Ferrand, France, a corporation of France.

A bead cable for automobile tire casings is provided consisting of a central wire core and a helically wound wire layer spaced from the core with unvulcanized rubber between them, the rubber yieldingly supporting the filaments for independent relative rotational movement and axial shifting movement while the bead cable is being incorporated into the tire casing and for equalizing the initial stresses in the filaments lengthwise and distributing the stresses among the various filaments during incorporation of the bead cable into the casing.

✦ ✦ ✦

No. 2,181,632, INSULATED ELECTRICAL CONDUCTOR, Patented November 28, 1939 by Herbert A. Winkelmann, Chicago, Ill., assignor to Marbon Corporation, Chicago, Ill., a corporation of Delaware.

It is claimed that this conductor has high di-electric strength, flexibility and water and oil resistance, as well as ozone and ultra-violet ray resistance, and comprises a conductor wire covered with a composition of an intimate mixture of rubber hydro-chloride and a basic stabilizer.

STANDARD OR SPECIAL DESIGN MACHINES AND EQUIPMENT

FOR

WIRE, ROD OR STRIP MILL

Strip Coilers — Cold Rolling Equipment — Rod Coilers

Galvanizing and Tinning Equipment — Scrap Bundling Machines

Wire Drawing Machines - - Continuous and for Fine Wire

Cotter Pin, Edging, Straightening and Cutting Machines

Cleaning and Pickling Equipment — Pointers — Swagers — Wire Frames

Wire Puller Tongs

High Grade Equipment at Present Day Prices — Your Inquiries Invited

BRODEN CONSTRUCTION CO.

ENGINEERS - - BUILDERS

Wire Mill and Cold Rolling Equipment

11730 Harvard Avenue — CLEVELAND

'Round the World With the Wire Industry

German Notes

WIRE export prices are largely fluctuating at this time. The German wire industry continues to sell for export, but most of the business is in Reichsmarks (clearing) with Scandinavia, the Baltic States, the Balkans, Holland, Switzerland, Italy and the Near East. Italy has bought about 15,000 t. of wire rods in Germany and Holland 2300 t. Otherwise wire rod exports from Germany are nearly stopped, but the wire export trade is running at about 70% of the average for the first half of this year, like the Balkans, the Baltics are buying more now in Germany being cut off from supplies from the West. Turkey, the Iran, Afghanistan and even Arabia are still buying in Germany. Russia has interest in wire ropes, wire mesh strand wire, steel wire and under the new trade agreement with Germany about 23,000 t. of wire products will be supplied up to December 31st to Russia, amongst which is 3000 t. of wire rods, 3400 t. of bright wire and about 1300 tons of wire ropes. The total export of wire products first half of this year to Russia totalled only 4100 tons. The Polish wire industry is operating again, as most of the machinery was not destroyed, but the whole production will be absorbed by the reconstruction of war-devastated areas. The Belgian free export prices are: wire nails £ (gold) 7.10 basis, barbed wire 9.10 to 10.0, galvanized wire basis 4—8 8.5.0, galvanized staple 9.7.6 bright staples 8.2.5, the extras are the same as ever, but the price for packing has gone up by about 25%. Belgium exported during September, October and the beginning of November about as follows: September 35-40% of normal, October 65-70 and November up to 85% of normal. The discount off the British Standard list for wire netting is about 75%. France and Great Britain maintain the export stoppage for all wire products. The French wire industry in the East (Lorraine) is idle same as all blast furnaces and steel mills which are not farther away than 30 km from the frontier, i.e., nearly ⅓ rd of the whole industry. Therefore France tries to buy more abroad.

✦ ✦ ✦

The Balkans

THE Balkan wire industry is very active, particularly the Hungarian, but the reports, that new large works will be built are a bit premature, as machinery supplies are difficult and the German machinery industry is selling now chiefly to Russia. Still the Balkans, particularly Greece, Rumania and Turkey would offer a good field for American wire machinery. Turkey's steel works scheduled to

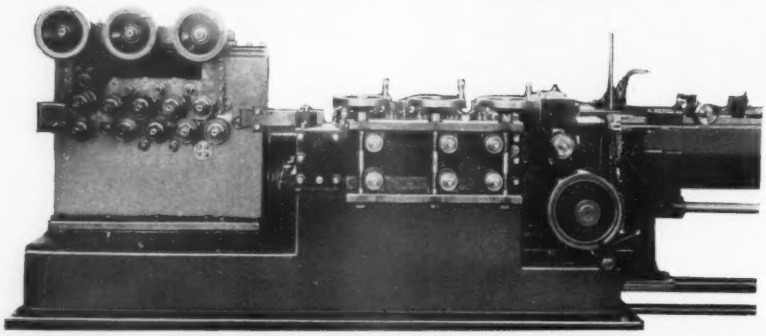
AUTOMATIC SHAPE STRAIGHTENER

with

FLYING SHEAR

for

Hexagon, Square and Rectangular Material



Will produce uniform quality rod without marking. Also high production, with accurate lengths.

THE HALLDEN MACHINE COMPANY

THOMASTON, CONNECTICUT

go into operation in June, were set for August, and now the opening of November has again been postponed, as vital machinery parts are still missing.

✦ ✦ ✦

HOLLAND leaves import contingents for wire unaltered but has stopped all export business, as did Switzerland.

✦ ✦ ✦

Experiments with Blast Furnace Slag

FOR a long time German metallurgists have concerned themselves with the problem of developing a profitable and extensive utilization of blast furnace slag. While a satisfactory solution has not been found, the extent to which it is considered possible to make use of the acidulous slag in the manufacture of cement and building bricks is the subject of a report by Herr Gustav Mussgnug, a member of the German Association of Iron Metallurgists.

✦ ✦ ✦

Iron and Steel Plant to be Built

THE Minister of the State Iron and Steel Department has announced that arrangements have been made for the construction of the iron and steel plant at Onekaka, New Zealand. Work on the plant is expected to get underway almost immediately and the start of production is planned for some time in 1942. The initial program contemplates an annual production of 104,000 tons of various types of iron and steel. It is planned that 20,000 tons of basic slag will be made available as a by-product of the Bessemer furnaces. A coke oven is to be installed in connection with which will be included a by-product plant to recover various materials from the coke oven gas.

✦ ✦ ✦

Belgian Producers Seek Output Control

THE Belgian Ministry of Economic Affairs announces that the Association of Belgian producers of drawn and rolled steel bars has appealed for output control by the Government. The Association requests a regulation for the period July 1, 1939, to December 31, 1941, forbidding production in excess of 60 per cent of the total capacity of the plants as established on June 30, 1939, or enlargement of plants' productive capacity or replacement of equipment if capacity is thereby increased. Objections to this proposal must be filed within ten days after its publication (on August 17, 1939) and supported with justification within 20 days.

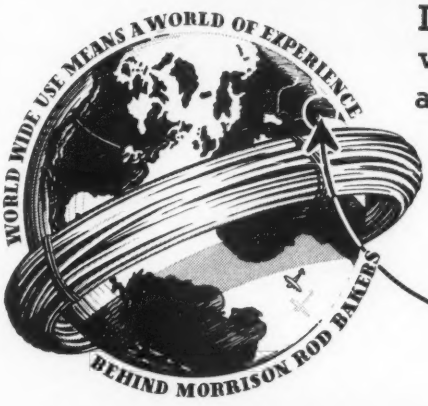
✦ ✦ ✦

Nail Factory at Hong Kong

THE office of the American Commercial Attache at Shanghai reports the establishment at Hong Kong of a nail factory capitalized at HK$200,000. It is also stated that the plant has a present daily output of 5 tons of nails.

(*Please turn to Page 76*)

"After 4 Years' Service Still 100 Percent"



In far-off India where performance counts!

"The Morrison bakers installed four year ago are still working 100 percent," reports a new American manager recently sent to operate a large Indian steel mill. Four years' top performance is vastly important in far-off India where advice or service cannot be had merely by a telephone call. The equipment must be right! While your own mill may not be so isolated, uniform production, freedom from trouble, and low cost that stays low are just as important. These Morrison qualities are just the same in distant India or merely around the corner--Morrison experience means your complete satisfaction.

INSTALLATION DATA

Type: Truck
Size: 16-truck
Work: Basic rods and wire
Time: 1 hr. (average)
Tons: 24 per hour
Fuel: Oil - direct fired

MORRISON ENGINEERED

Morrison Truck Type and Flash Bakers available in either oil or gas-fired; direct or indirect.

U S Patent 1,999,513 2,156,303

401

MORRISON ENGINEERING CORP
5005 EUCLID AVENUE
CLEVELAND, OHIO

'Round the World With the Wire Industry

(*Continued from Page 75*)

Wire Nail Factory in Java

APPROVAL has been granted Messrs. W. P. Lubbers and O. G. F. Paulssen van Lunaeberg, partners in the firm Ingenieursbureau Ir. J. Fabritius Schutter, Bandoeng (West Java) to set up a wire nail factory in Java. The approved production would be 7,500,000 kilograms of nails per annum or approximately one-half the 1938 imports of 14,615,000 kilograms (for all the Netherlands Indies).

✦ ✦ ✦

Barbed Wire and Staples Sold at Cost

BY decree No. 1296 of 1939, commercial establishments throughout Colombia normally handling barbed wire and staples must hereafter sell these items at cost. This decree, aimed at helping agriculturalists and live stock raisers, required the Caja de Credito Agrario, Industrial y Minero to distribute this material through the commercial channels noted.

✦ ✦ ✦

New Usage of Glycerine in Abrasive Products

TO associate glycerine with abrasive products may sound surprising to the average person. Yet a check of research literature and patents reveals many phases of this industry where glycerine or its derivative resins are finding important uses today. That glycerine as such may be helpfully added to binding materials as plasticizers to maintain the flexibility of abrasive sheets is one usage. More frequently however, glycerine-containing resins such as glycerol-phthalate or alkyd resins, modified by various additions to meet particular needs, are employed as binding agents for abrasive substances.

✦ ✦ ✦

IN one of the earlier patented processes such an alkyd resin is employed as the adhesive or binder in the manufacture of water-resistant abradants such as emery paper or whetstones. In another instance such a glycerine-containing resin is used as a binder in making flexible sandpapers.

✦ ✦ ✦

OTHER methods employ modified glycerine-phthalate resins as binders for similar flexible abrasive articles using paper or cloth as the support for the abradant materials.

✦ ✦ ✦

ACCORDING to a fairly recent British patent, a composition for making grinding implements consists of:

Diamond powder	**7 parts**
Synthetic sapphire	**2 parts**
Alum	**1 part**
Clay	**2-4 parts**
Glycerine	**3 parts**
Glue size	**4 parts**

✦ ✦ ✦

THESE are molded together and burnt at 1,000-1,500°. In this instance glycerine apparently serves to maintain the plasticity and workability of the mass during shaping, prior to burning.

✦ ✦ ✦

Washer Firm Publishes New Stock List

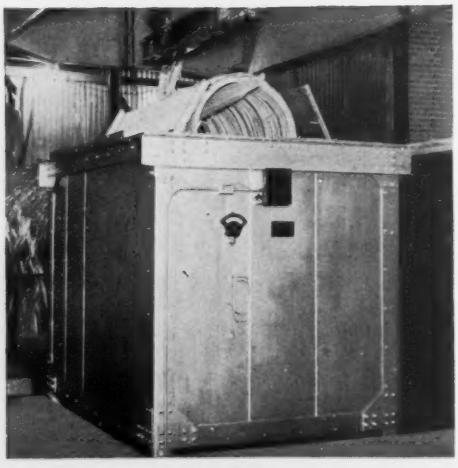
THE Wrought Washer Mfg. Co., of Milwaukee, Wis., world's largest producer of washers, expansion plugs, stampings, tools and dies, serving the wire fabricating industry, has announced the publication of a new stock list—No. 55-C—available to wire product manufacturers upon request.

✦ ✦ ✦

THIS new publication lists thousands of washer specifications in various materials, including steel, brass, copper, aluminum, fibre, etc., carried in actual inventory available for immediate shipment. Those sizes permanently maintained in stock are so designated, thus enabling manufacturers to select for standard production as well as new assemblies the particular sizes on which they can always secure prompt delivery.

CARL-MAYER HI-SPEED TRADE MARK **ROD BAKER**

Far Ahead in comparative tests!



Large savings per pin in baking time.

Produces work of highest calibre.

Heavy Duty Construction.

Carl-Mayer Hi-Speed Rod Bakers have a more efficient heating and ventilating system . . . The patented Blow-Off feature removes moisture without rolling, bumping or agitating the coils . . . Write for complete details.

Illustration shows a Carl-Mayer Hi-Speed Rod Baker in a large Canadian steel plant.

OVER 20 YEARS EXPERIENCE

The CARL-MAYER Corp.
3030 Euclid Ave., CLEVELAND, OHIO.

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WIRE AND WIRE PRODUCTS
for
February, March, August, November and December 1936. January, February, April and May 1937
WIRE AND WIRE PRODUCTS
300 Main St., Stamford, Conn.

A Correlation of the Factors and Effects of Cold Drawing of Wire Rods

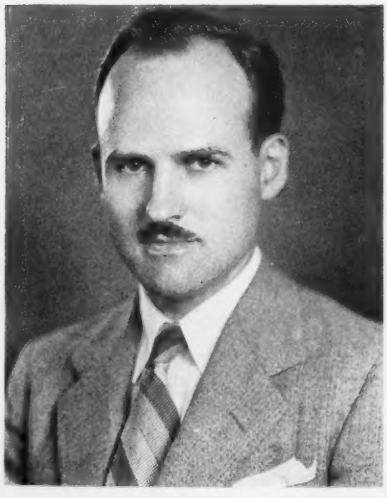
(*Continued from Page 29*)

count when setting specifications. Too often one or two samples are used as a means of determining the type of material required and the limits of specification based on their performance. These may be either too wide or too narrow a specification, thus either overburdening the producer or giving the fabricator unsatisfactory service.

✦ ✦ ✦

THUS only by continued concerted effort on the part of the wire producer in obtaining and using information on the effects of the processes of production on the processes of the fabricator, and close collaboration of the fabricator with the producer can the best results be obtained. Today this bond of friendship and cooperation is indeed developing to a point where the fabricator and producer are a part of the same family and certainly great benefits are being reaped by both.

✦ ✦ ✦



J. R. Gier

J. R. GIER has been engaged in metallurgical work in the Westinghouse Research Laboratories since 1925. During the last few years he has specialized on problems in processing and using protective gases for heat treating metals. He is a graduate of Carnegie Institute of Technology.

ON THIS OCCASION — THE PRESENTATION
OF THE FIRST MORDICA MEMORIAL LECTURE

AN APPRECIATION

The representatives of Warner Company from their many personal contacts with John Mordica came to know him well.

They long recognized his thorough, practical knowledge of Wire-making and Wire, and respected his high abilities as an Organizer.

Today they remember with deep regard his outstanding, warmly human character as a Man.

It has seemed both appropriate and timely to here make this statement of honest appreciation.

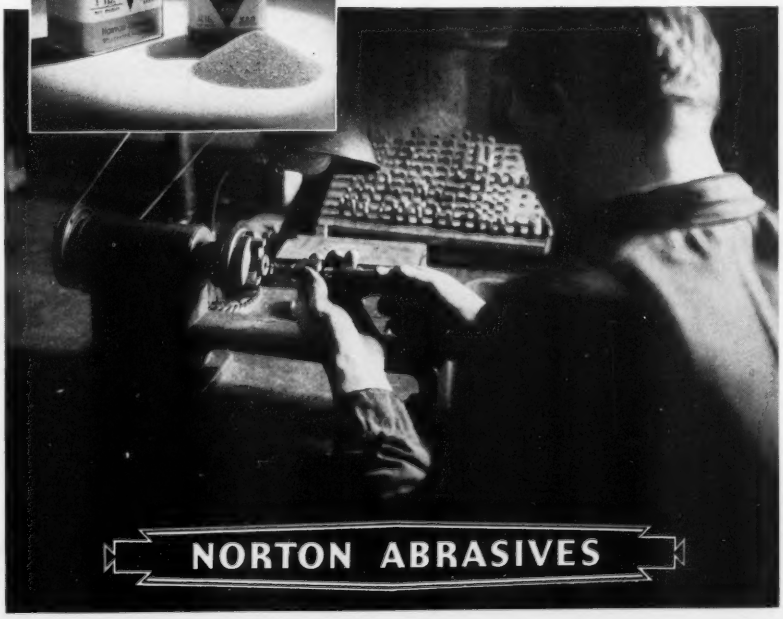
Warner Company

Pittsburgh Bellefonte Philadelphia New York City

NORBIDE ABRASIVE for

Efficiently and Economically Shaping, Grinding and Polishing Cemented Carbide Wire Drawing Dies. Information on request.

NORTON COMPANY, Worcester, Mass.



N-46

Adjustable-Speed Drive Accelerates Cable Forming and Wrapping

CABLE forming and wrapping operations in the plant of the Crescent Insulated Wire & Cable Co., Trenton, N. J., require accurate control of the speeds of three principal units: (1) a rotating table which carries the supply reels, (2) a wrapping or taping head, and (3) a capstan, which draws the finished cable through the taping head and discharges it onto reels.

✦ ✦ ✦

THE insulated wire, drawn simultaneously from several supply reels mounted on the rotating table, must move at a uniform speed through the wrapping head and onto the capstan to insure an even twist to the finished cable. For this reason, the rotating table (in the background) and the capstan (in the foreground) are driven by a constant-speed motor, operating through the same chain drive to both units.

✦ ✦ ✦

ON the other hand, for various diameters and specifications of cable, the amount of wrapping which is wanted will vary. Changing the speed of rotation of the wrapping head, or the rate of passage of the cable through it, or a combination of the two, are the choices of method available to change the amount of lap of the covering tape. Because this is the case, the taping head, carrying two spools of cable tape, is independently driven to permit of a wide range of operating speeds.

✦ ✦ ✦

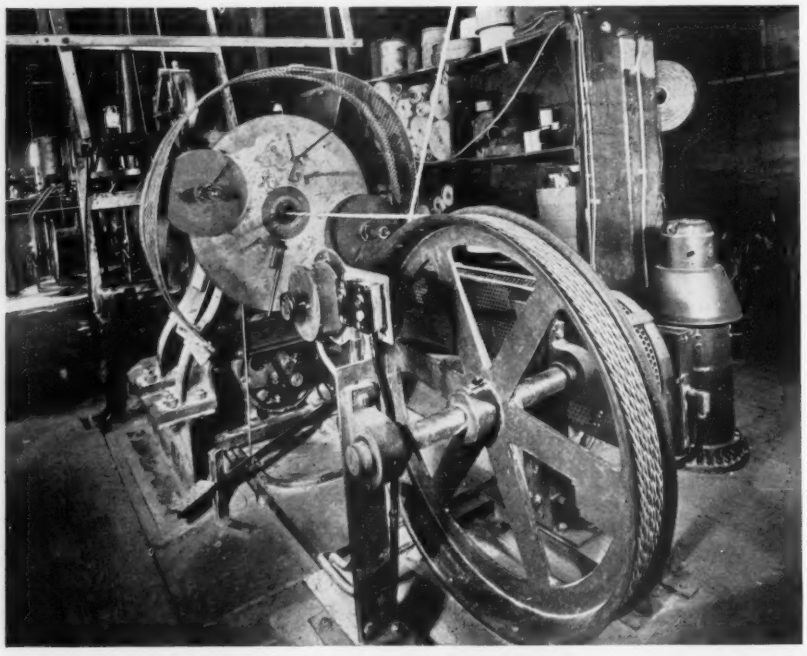
A NEW Reliance V-S Drive has replaced the system of gears and pinions formerly used to obtain speed changes. A wide range of rpm. is now available by simply turning a speed adjuster handle located beside the start-stop buttons on the frame of the machine.

✦ ✦ ✦

INCREASED uniformity of product has been made possible, production has been speeded up, and time out for making speed changes has been entirely eliminated.

✦ ✦ ✦

DESPITE the fact that both the motor and the new adjustable-speed unit must operate in an atmosphere which is heavily laden with talc and soapstone dust, there has been no interruption to operation, no breakdown, and no unusual maintenance.



Cable forming and wrapping is speeded with application of new adjustable-speed electric drive, recently developed by The Reliance Electric & Engineering Company, Cleveland. ✦ ✦

FOR

THE CLEANING HOUSE . . . . . .
HOT GALVANIZING ROOM . . . . .
ELECTRO GALVANIZING ROOM . . .

Hot or Cold Muriatic

•

Hot or Cold Sulphuric

•

Abrasion Resistance

•

DURIRON and DURICHLOR EQUIPMENT

Centrifugal Pumps—standard and self-priming.
Valves—"Y", Angle, Check, Quick-Releasing, Duriron-Nordstrom lubricated.

Tank Outlets—Heating Coils for Cleaning Tubs—Pipe and Fittings for Acid Handling—Acid Resisting Tank Fittings—Pickling Crates—Yokes—Heat Exchangers—Heating Jets.

WILL REDUCE COSTS, SAVE TIME, IMPROVE RESULTS

Write for bulletins on acid handling equipment

The Duriron Company, Inc.

445 N. FINDLAY ST. DAYTON, OHIO

RHOADS
Tannate
LEATHER PACKINGS
CUP LEATHERS • U-LEATHERS
FLANGE LEATHERS • V-LEATHERS

★YOU SAVE TREBLY when you use TANNATE Leather Packings! You have fewer packing replacements . . . less installation expense . . . less time lost due to packing troubles!

TANNATE, from which TANNATE Packings are made, is about 35% stronger than most oak leather — better resists chemicals — better withstands wear and has a service life you will measure in YEARS. It is uninjured by temperatures up to 175° F. . . . and a specially heat-resistant TANNATE can stand temperatures up to 212° F.

Further — TANNATE Packings are impregnated with suitable compounds to adapt them exactly for the service they must meet.

Ask us about TANNATE service reports . . . TANNATE'S record in use in the field. It is an impressive story full of clues for savings for you. No obligation—just write:

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J. E. RHOADS AND SONS
35 N. Sixth St., Philadelphia, Pa.
New York, Chicago, Atlanta, Cleveland
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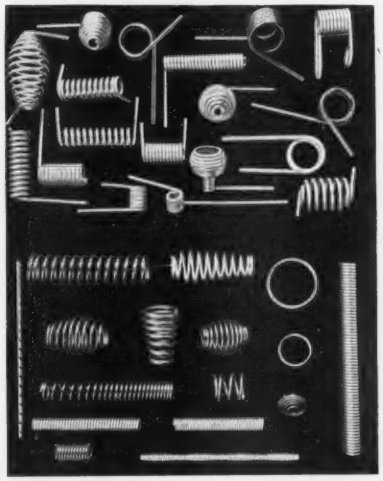
STEEL REELS AND DRUMS
for
WIRE AND CABLE INDUSTRY
R.B. HAYWARD CO.
1714 Sheffield Ave. Chicago, Ill.

Spring Coiling Machine Coils Torsion Springs!

THE Torrington Mfg. Co. of Torrington, Conn., is about to offer a Universal Spring Coiling Machine—a machine which will make all of the usual compression and extension springs and, in addition, will coil many types of torsion springs.

✦ ✦ ✦



TORSION springs are produced by a special attachment which is applicable to all Torrington coilers now in the field.

✦ ✦ ✦

THE attachment increases production of Torsion springs with remarkable accuracy of extended ends.

✦ ✦ ✦

TORRINGTON has established an experimental department for the sole purpose of bringing better equipment and methods to the Spring Making Trade. Similar revolutionary features will be announced from time to time, all of which will be attachments to present Torrington Machines.

✦ ✦ ✦

Manufacture and Uses of Stainless Steel Wire

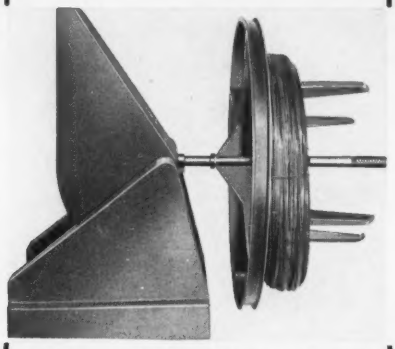
(Continued from Page 52)

gentlemen, and no further discussion of either of the papers presented to us this morning I think that it is drawing close to the time to adjourn. I would like, in the name of The Wire Association and the various members present, to extend our appreciation and thanks to Mr. Watkins for this very fine paper he has presented to us, and the meeting will stand adjourned.

. . . Recessed at 11:50 A. M. . . .

THE "SHIFTWEIGHT" TILTING WIRE REEL

A counter-balanced tilting wire reel with full 42" diameter upper guard rings, allowing perfect feeding of wire off the coil and absolutely "Snarl Proof."



Weight so distributed that reel need not be bolted to floor.

Moslo Machinery Inc.
5005 Euclid Ave.
Cleveland Ohio

Wire Reels Rod Bakers
Spot Welders Roll Straighteners
Wire Straightening and Cutting
✦ ✦ ✦ Machines ✦ ✦ ✦

NEW 99% SOAP INSURES CORRECT LUBRICATION

Nopco's new Soap LX has been prepared especially for the dry drawing of steel wire. Its superiority is due to its actual soap content—99% active dry soap.

Because of this high pure soap content, Nopco Soap LX possesses plus values that will effect economy in your drawing operations.

Free from glycerine, salt or fillers of any kind, Nopco Soap LX insures correct lubrication with longer die life, better finish and higher yields per pound of soap.

Write for a Technical Data Bulletin or better still, order enough for a trial—see for yourself.

REG. U.S. PAT. OFF. NOPCO
NATIONAL OIL PRODUCTS CO.
HARRISON, N. J.
BOSTON • CEDARTOWN, GA. • CHICAGO • SAN FRANCISCO

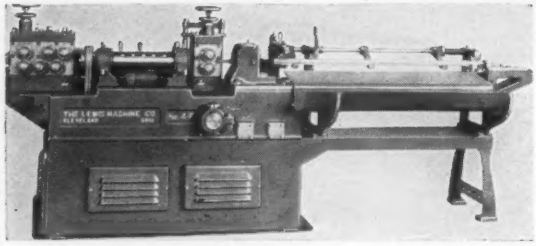
Learn about **PARALAN**

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



Machines for 1/16" to ¾" rod
Round
Square
Flat
Hexagon
Ferrous and Non-Ferrous

Automatic
High Speed
Heavy Duty

The Sign of Dependable Service:
WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

THE LEWIS MACHINE CO., 3445 E. 76 St., Cleveland, Ohio

NEW ENGLAND BUTT COMPANY
ESTABLISHED 1842
BUILDERS OF
Insulated Wire Machinery
Write for catalog

Dept. W-1
PROVIDENCE, R. I.

CHICAGO OFFICE
20 NORTH WACKER DRIVE

STEELSKIN
REG. U. S. PAT. OFFICE
For High or Low Carbon Wire
WIRE DRAWING SOAPS
Established 30 years
R. H. MILLER CO., Inc. Homer, N. Y.

Paulsen-Webber Cordage Corporation Enlarges

AN increase in their personnel, additional warehouse space and completely remodeled offices are announced by **Paulsen-Webber Cordage Corporation,** of New York City. **Paulsen-Webber** are distributors of Wire Rope and Manila Rope.

✦ ✦ ✦

AMONG those added to their staff is Horace Chrystal, prominent in steamship circles and former owner of the Chrystal Iron Works in Brooklyn, New York. Mr. Chrystal has joined the sales division of the organization.

✦ ✦ ✦

THE warehouse space has been doubled by the addition of the ground floor in the adjacent building. The additional space will enable **Paulsen-Webber** to materially increase their wire and manila rope stock which will, they declare, result in a wider and more efficient service to their customers.

✦ ✦ ✦

PAULSEN-WEBBER have been serving the marine and industrial fields since early in 1923. Officers of the corporation include Fredrik Paulsen, president; George H. Webber, secretary-treasurer; and Charles D. Gritman, vice president.

✦ ✦ ✦

New, Low Cost Wire Stripper With Vacuum Collector

A NEW, lower cost, power-driven, brush-type wire stripper, known as the Ideal 9-C Model, is announced by the Ideal Commutator Dresser Company, 1936 Park Avenue, Sycamore, Ill. This new unit greatly speeds up production work in stripping wires. A vacuum attachment draws the insulation materials into a drawer in the base of the unit, thus eliminating dust and dirt of stripping operations.

✦ ✦ ✦

THIS stripper strips cotton and enamel, silk and enamel, string asbestos and other light insulations from round, flat or rectangular solid or stranded wire. It is especially effective in cleaning fine "Litz" wires, in removing

gummy insulation imbedded in stranded wires and in cleaning the new "Formex" magnet wire.

✦ ✦ ✦

OPERATION of the new wire stripper is by single, direct-belt drive from the ¼ H.P. motor to the special steel wire brushes.

✦ ✦ ✦

Major Browning Addresses Fine Wire Association

AT a meeting of the Fine Wire Manufacturers' Association held at the Waldorf-Astoria in New York on December 20th, Major Browning and Messrs. Graham and Seibert of the United States Signal Corps discussed in some detail the current specifications and tests for signal wire.

✦ ✦ ✦

PRACTICALLY the full membership was present and listened with interest to the problems involved in securing a proper supply of material for use in case of emergency and pledged full co-operation to the Department. The latest specifications were introduced and discussed in considerable detail and the reason for each item in the specifications was made clear.

✦ ✦ ✦

MAJOR BROWNING and his associates also gave attention to the tests set up for signal wire and pointed out that it was the desire of the Government to make these tests sufficiently simple and practicable so that all manufacturers would know exactly what is required and could get into production with the least delay in case of need.

✦ ✦ ✦

THE manufacturers were highly impressed with the cooperative attitude of the Signal Corps and the thoroughness with which it has canvassed the problem.

✦ ✦ ✦

THE meeting expressed its deep appreciation of the conference and its gratitude to Mr. Brown of the Wire Association for his part in arranging it.

TRY SMIT SUPERIOR DIAMOND POWDER

FINEST Raw Material reduced to sharp cutting fragments under controlled conditions.

UNIFORM Sizes from #1 to #6 assured by our particle size analyzer.

DEPENDABLE Performance is the result of using the consistently uniform Smit Diamond Powder.

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Add a dash of RODINE to the pickling bath. It saves acid and metal, minimizes brittleness, and lowers pickling costs.

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Houghton Products for the Metal Working Industries

THE above is the title of a new booklet just released by the E. F. Houghton & Company of Philadelphia. The booklet contains factual data on Cutting Oils, Carburizers, Heat Treating Salts, Inhibitors, etc. The reference data is useful to the metal-working executive.

✦ ✦ ✦

A COPY of this booklet may be obtained by addressing Information Department, WIRE AND WIRE PRODUCTS.

✦ ✦ ✦

Low Pressure Oil Burner

A BULLETIN recently issued by the Hauck Manufacturing Company of Brooklyn, New York, describes their "all in one" low pressure oil burner. The bulletin states that the burner does not require extra valves but is all ready to hook up to temperature control equipment for accurate combustion and temperature control. The bulletin gives complete information on how the burner works and how it is applied.

✦ ✦ ✦

A COPY may be obtained by addressing Information Department, WIRE AND WIRE PRODUCTS.

✦ ✦ ✦

Goggle Improvements

AN attractive two-color news bulletin which explains fully all recent improvements in Ful-Vue Safety Goggles has just been published by American Optical Company, Southbridge, Mass. Copies will be mailed on request.

FEATURES referred to are the Goggles' new double-braced bridge with its exceptional structural strength that assures longer service; the three eye sizes and three bridge sizes that permit more exact fitting to workers; the special sizes of Ful-Vue Goggles designed to fit every type of face; and the Transportation Goggle, especially developed to protect railroad men, truck and bus drivers against wind, dust, cinders, flying particles, and glare.

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January, February, April and May 1937
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Hard Carbide Patent Litigation Settled

ANNOUNCEMENT has been made by Vanadium-Alloys Steel Company and Philip M. McKenna that the litigation between them involving the McKenna patents on cemented hard carbide compositions has been settled amicably and the suit has been terminated.

✦ ✦ ✦

MR. McKENNA has been licensed to continue in the manufacture and sale of cemented hard carbide compositions under the name of McKenna Metals Company, as heretofore.

✦ ✦ ✦

Welding Wire Co. Starts Production at New Plant in York

THE Welding Wire Company, which recently moved its plant and business from New England, has started production in a portion of the former plant of the American Caramel Company at Walnut and Broad Streets, York, Pa.

✦ ✦ ✦

THE company manufactures automatic welding wire of the large diameter type, produced on electrically operated automatic machines. The finished product is used extensively by manufacturers of electric refrigerators, water and gas tanks, pipe and army tanks. Present capacity is 250 tons annually, which will be substantially increased.

✦ ✦ ✦

Allegheny Ludlum to Expand Stainless Steel Plant at Buffalo

ALLEGHENY Ludlum Steel Corporation, has purchased the physical property at its Buffalo plant. The plant will be enlarged to make possible the production of a greater quantity of stainless steel. The expansion plans include addition of a second electric furnace, eventual enlarging of the building, and installation of additional equipment.

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Etching Solutions for Microscopic Examination of Metals

A NUMBER of glycerine-containing metal-etching solutions of interest to everyone in the metallurgical field are presented by Dr. B. Egeberg and N. E. Promisel in a recent article in "Metal Industry".

✦ ✦ ✦

FOR etching aluminum and its alloys, these authorities recommend that the freshly polished, cleaned specimens be warmed in hot water and treated immediately with the following etchant:

Nitric acid	1 vol.
Hydrofluric acid	2 vol.
Glycerine	3 vol.

✦ ✦ ✦

WHITE metals such as tin, lead, antimony, bismuth and their alloys, as well as Britannia metal, may be etched with the following solution:

Nitric acid	1 vol.
Acetic acid	3 vol.
Glycerine	15 vol.

✦ ✦ ✦

AFTER proper etching, the specimens are, in all cases, rinsed in hot running water and dried in an air blast.

✦ ✦ ✦

Stainless Steel "Slide Rule"

A STAINLESS steel machinability "slide rule" incorporating the condensed findings of two years of intensive research on the machining of stainless steel, has been produced by Rustless Iron and Steel Corporation here for men and firms engaged in fabricating the metal.

✦ ✦ ✦

THE research program was carried on by a force of machinists and metallurgists, and covered the turning, forming, threading, drilling, tapping and reaming of stainless steels. Thousands of samples were machined at various speeds, and with various types of tools.

✦ ✦ ✦

BY setting the slide on the chart to the type of stainless steel to be machined, data on speeds, feeds, and cuts may be read directly. The reverse of the chart carries suggestions as to tool design, grinding and coolants.

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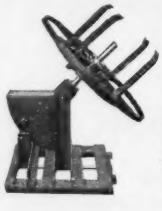
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WHERE TO BUY

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ABRASIVES—
Norton Co., Worcester, Mass.

AIR DRAW FURNACES—
Carl-Mayer Corp., Cleveland, Ohio

ANNEALING POTS AND BOXES—
Scudder, E. J. Fdry. & Machine Co., Trenton, N. J.

ANODES—Nickel
Seymour Mfg. Co., Seymour, Conn.

ANTI-RUST—Compound
Magnus Chemical Co., Garwood, N. J.
National Oil Products Co., Harrison, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

AUTOMATIC SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

BAKERS—Flash
Morrison Engineering Corp., Cleveland, O.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, O.
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Corp., Cleveland, O.
Moslo Machinery, Inc., Cleveland, O.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BORTZ—Diamond
Smit, J. K. & Sons Inc., New York, N. Y.

CARRIERS—Braider, High Speed
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Parkin Co., The Wm., Pittsburgh, Pa.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Duriron Co., The, Dayton, O.
Hauser-Stander Tank Co., Cincinnati, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.
National Oil Products Co., Harrison, N. J.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

COILERS AND SPOOLERS FOR INSULATED WIRES—
Entwistle, James L., Pawtucket, R. I.

COLD HEADERS—
Ajax Manufacturing Co., Cleveland, Ohio.

COPHOLDERS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUSTOM ROD ROLLING—
Wilbur B. Driver Co., Newark, N. J.

CUSTOM WIRE DRAWING—
Hy-Carbo Steel Co., Lowell, Mass.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIAMOND POWDERS—
Smit, J. K. & Sons Inc., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Co., New York, N. Y.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Inc., Irvington, N. J.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

WHERE TO BUY, Continued

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Inc., Irvington, N. J.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Globe Wire Die Co. (M. V. Dreyspool), New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., New York, N. Y.

EQUIPMENT—Insulation Testing
Entwistle, James L., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FLASH BAKERS—
Morrison Engineering Corp., Cleveland, O.

FURNACES—Annealing
Carl-Meyer Corp., The, Cleveland, O.
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, O.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Lee-Wilson Engineering Co., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Galvanizing
Lee-Wilson Engineering Co., Cleveland, Ohio

FURNACES—Hardening and Tempering
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, Ohio.

GALVANIZING EQUIPMENT—
Lee-Wilson Engineering Co., Cleveland, Ohio

GEARS—Wire Mill
Farrel-Birmingham Co., Ansonia, Conn.

GRINDERS—ROLL
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

HI-SPEED BAKERS—
Carl-Mayer Corp., Cleveland, O.

HOISTS—Electric Traveling
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

HOT ROLLED RODS—
Driver Co., Wilbur B., Newark, N. J.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
National Oil Products Co., Harrison, N. J.
Parkin Co., The Wm., Pittsburgh, Pa.

INSTRUMENTS—Electrical
Entwistle, James L., Pawtucket, R. I.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—
Warner Company, The, Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
Miller Co., R. H., Homer, N. Y.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller Co., R. H., Homer, N. Y.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson Machine Co., A. H., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Entwistle, James L., Pawtucket, R. I.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading with Wire Drawing Attachment
Ajax Manufacturing Co., Cleveland, Ohio.

MACHINERY—Copper Wire Drawing and Rolling
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
Moslo Machinery Inc., Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson Machine Co., A. H., The, Bridgeport, Conn.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson Machine Co., A. H., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing
Lee-Wilson Engineering Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Lee Wilson Engineering Co., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

WHERE TO BUY, Continued

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY — Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Rubber for Insulating Wire
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.
Royle, John & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa
Broden Construction Co., Cleveland, O.
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
Moslo Machinery, Inc., Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
Nilson Machine Co., A. H., The, Bridgeport, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt, Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Industrial
Carl-Mayer Corp., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, O.

PACKING—Tannate Leather
Rhoads & Sons, J. E., Philadelphia, Pa.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS
American Chemical Paint Co., Ambler, Pa.
National Oil Products Co., Harrison, N. J.
Parkin Co., The Wm., Pittsburgh, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

RECORDERS—Fault and Reel
Entwistle, James L., Pawtucket, R. I.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery, Inc., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Corp., Attleboro, Mass.
Moslo Machinery, Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster Co., F. B., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

WHERE TO BUY, Continued

REELS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Moslo Machinery Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B. Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B. Co., New Haven, Conn.
Stevens Metal Products, Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, O.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS
Carl-Mayer Corp., The, Cleveland, O.
Morrison Engineering Corp., Cleveland, O.
Moslo Machinery, Inc., Cleveland, O.

RODS—Hot Rolled to Order
Wilbur B. Driver Co., Newark, N. J.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Co., Kansas City, Mo.

ROLL STRAIGHTENERS—
Moslo Machinery, Inc., Cleveland, O.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, Co., R. H., Homer, N. Y.
National Oil Products Co., Harrison, N. J.
Vanco, Co., The, Manchester, Conn.

SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Hayward Co., R. B., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Corp., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TAKE-UPS FOR CABLE, HOSE, LEAD PRESSES AND SHEET RUBBER—
Entwistle, James L., Pawtucket, R. I.

TANKS—Acid
Hauser-Stander Tank Co., Cincinnati, O.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Lead Lined
Hauser-Stander Tank Co., Cincinnati, O.

TANKS—Pickling
Hauser-Stander Tank Co., Cincinnati, O.

TANKS—Rubber Lined
Hauser-Stander Tank Co., Cincinnati, O.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Wooden
Hauser-Stander Tank Co., Cincinnati, O.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Entwistle, James L., Providence, R. I.
Scott Co., Henry L., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

TURKS HEAD—
Standard Machinery Co., Auburn, R. I.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, O.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.

WIRE DRAWING—High Grade Custom
Hy-Carbo Steel Co., Lowell, Mass.

WIRE—Electric
Driver Co., Wilbur B., Newark, N. J.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Resistance
Driver Co., Wilbur B., Newark, N. J.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Seymour Mfg. Co., Seymour, Conn.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Stainless Steel
Driver Co., Wilbur B., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel——Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.

WIRE AND RIBBON—Special Alloy
Driver Co., Wilbur B., Newark, N. J.

WIRE AND RIBBON—Monel
Driver Co., Wilbur B., Newark, N. J.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non Ferrous
Driver Co., Wilbur B., Newark, N. J.
Hudson Wire Co., Ossining, N. Y.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

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